

## **2.0 FACILITY CHARACTERIZATION**

This section presents background information about the DCD that will be used as a basis for performing the human health risk assessment (HHRA). Section 2.1 describes the current mission, history, and current RCRA-regulated activities conducted at DCD. Section 2.2 describes the RCRA-regulated emissions sources that will be evaluated in the HHRA. Section 2.3 describes the procedures used to identify COPCs that will be evaluated in the HHRA. Section 2.4 describes the procedures used to estimate the stack gas emission rate of each COPC from each emission source in order to complete the HHRA.

### **2.1 DESERET CHEMICAL DEPOT**

DCD is a government owned and operated installation under the administration of the U.S. Army Soldiers and Biological Chemical Command (SBCCOM), which is under the direction of U.S. Army Materiel Command (AMC). The threefold mission of DCD involves (1) storage, inspection, monitoring, and maintenance of chemical munitions; (2) demilitarization of stockpiled chemical munitions; and (3) testing of alternative chemical munition disposal methods. RCRA-regulated activities at DCD related to this mission include the treatment of munitions at TOCDF and CAMDS, a variety of hazardous waste storage activities (including the Area 10 Storage facility where stockpile chemical munitions are stored), and the Rapid Response System (RRS) (see Section 2.1.3) (DSHW 1989; 1993; 1999b; 2000).

DCD is one of eight locations in the continental U.S. where chemical munitions are stored. The munitions stored at DCD contain nerve agents (GA, GB, and VX) and blister agents (H, HD, HT, and

Lewisite) (Aberdeen Proving Grounds [APG] 1989). The nerve agents are odorless, colorless, and tasteless, and are highly toxic in both liquid and vapor forms. Fatal doses of nerve agents result in convulsions and death due to respiratory paralysis within minutes of exposure. The blister agents produce blistering of exposed tissues, causing injuries to the skin, eyes, and respiratory tract. The chemical stockpile at DCD is stored in three basic configurations (APG 1989):

- Projectiles, cartridges, mines, and rockets containing propellant and/or explosives
- Projectiles and aircraft-delivered munitions that do not contain explosive components
- Large quantities of bulk agent stored in ton containers made of steel

Table 2-1 is a summary of the chemical stockpile at DCD, which represents about 44.5 percent of the total U.S. chemical munitions stockpile.

The following subsections describe the facility (1) location, (2) history and operations, and (3) current RCRA-regulated activities.

### **2.1.1 Facility Location**

DCD is a 19,400-acre facility located in the moderately flat and arid Rush Valley, Tooele County, Utah (ATK 1996; Tetra Tech 2000b). Rush Valley is surrounded by the Great Salt Lake to the north, the Oquirrh Mountains to the east, the West Tintic and Sheeprock Mountains to the south, and the Stansbury and Onaqui Mountains to the west (Tetra Tech 2000b). DCD is approximately 50 miles southwest of Salt Lake City, 20 miles south of the city of Tooele, 20 miles south of the Tooele Army Depot (TEAD), 30 miles south of the Great Salt Lake, and 38 miles west of the city of Provo (see Figure 2-1). TOCDF is located adjacent to the Area 10 Storage facility in the west central portion of the DCD. CAMDS is located about 2 miles southwest of TOCDF. The RRS is located in Building 4553 at DCD, about 1 mile south of the main entrance to DCD (DSHW 2000b).

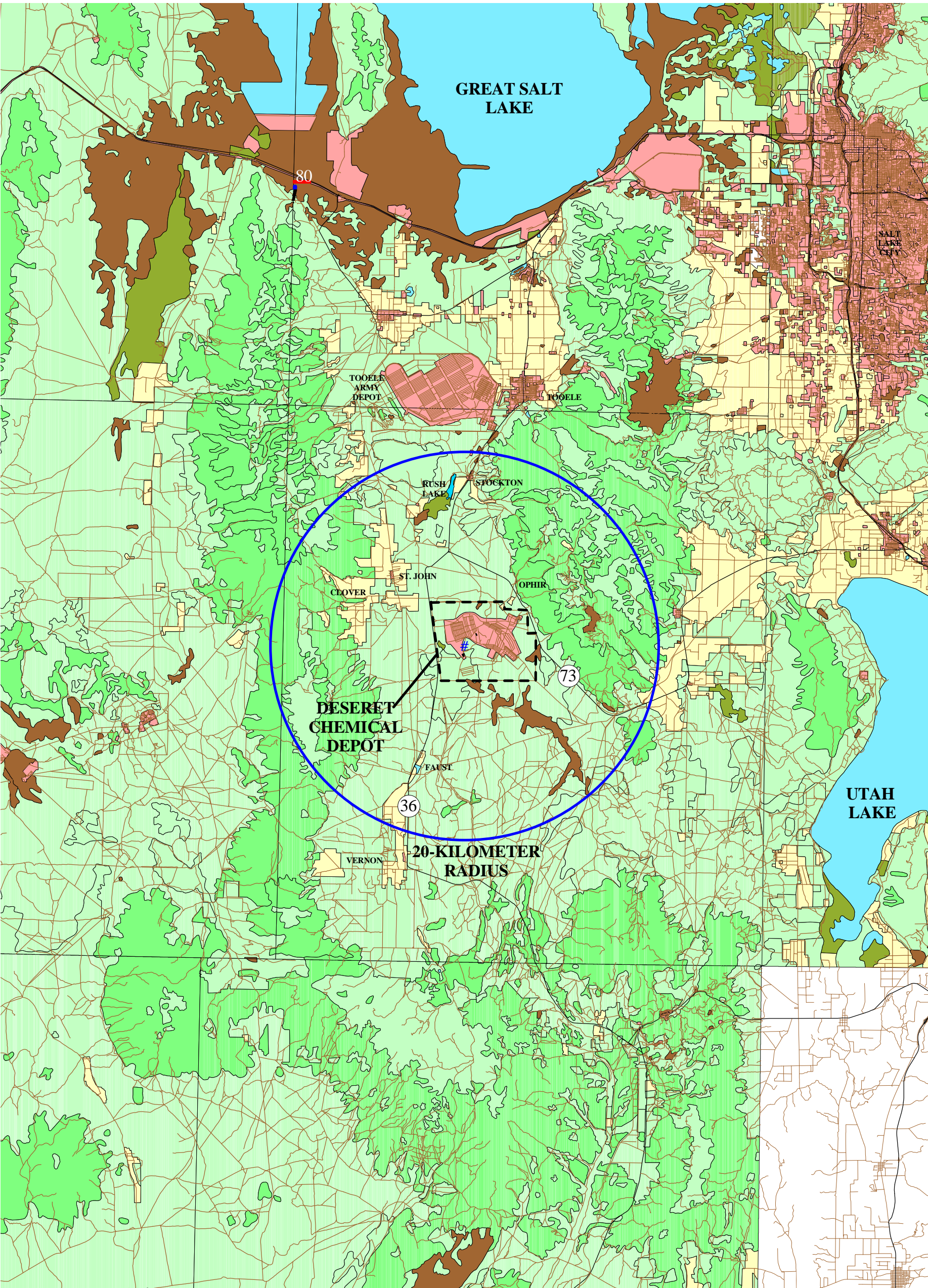
**TABLE 2-1**

**CHEMICAL MUNITIONS STOCKPILE  
DESERET CHEMICAL DEPOT**

<b>Agent</b>	<b>Item</b>	<b>Quantity</b>	<b>Pounds</b>
HT	4.2-inch cartridges	62,590	363,020
HD	4.2-inch cartridges	976	5,860
HD	Ton containers	6,398	11,383,420
H	155mm projectiles	54,663	639,540
L	Ton containers	10	25,920
GA	Ton containers	2	2,820
TGA	Ton containers	2	1,280
TGB	Ton containers	7	6,960
GB	105mm cartridges	119,400	194,620
GB	105mm projectiles	679,303	1,107,260
GB	155mm projectiles	89,141	579,420
GB	M55 rockets	28,945	309,720
GB	M56 rocket warheads	1,056	11,300
GB	WETEYE bombs	888	308,140
GB	750 lb. Bombs	4,463	981,860
GB	Ton containers	5,709	8,598,200
VX	155mm projectiles	53,216	319,300
VX	8-inch projectiles	1	20
VX	Mines	22,690	238,240
VX	M55 rockets	3,966	39,660
VX	M56 rock warheads	3,560	35,600
VX	Spray tanks	862	1,168,880
VX	Ton containers	640	910,960

Source: PMCD 2000



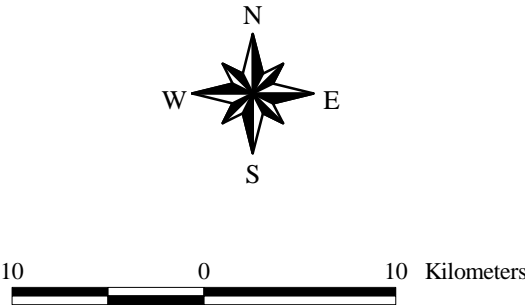



LEGEND

- |                                |   |
|--------------------------------|---|
| <b>LAND USE CLASSIFICATION</b> | <b>DESERET CHEMICAL DEPOT</b>                       |
| AGRICULTURAL                   | BOUNDARY  |
| BARREN LAND                    |   |
| FOREST LAND                    | # CENTRIC POINT FOR ATMOSPHERIC DISPERSION MODELING |
| URBAN OR BUILT-UP LAND         |   |
| MIXED RANGELAND                |   |
| WATER                          | (36) STATE HIGHWAY                                  |
| WETLAND                        | INTERSTATE HIGHWAY                                  |

NOTES: 20-KILOMETER RADUS IS FROM A POINT CENTERED ON THE TOCDF AND CAMDS FACILITIES. GRID IS BASED ON THE NORTH AMERICAN DATUM 1927 1000-METER UNIVERSAL TRANSVERSE MERCATOR COORDINATE SYSTEM. LAND USE CLASSIFICATION FOR THE LOWER RIGHT CORNER OF THE MAP COULD NOT BE DISPLAYED DUE TO A FILE ERROR.


SOURCES: U.S. ENVIRONMENTAL PROTECTION AGENCY, 1977, AND THE STATE OF UTAH DIVISION OF INFORMATION TECHNOLOGY SERVICES AUTOMATED GEOGRAPHIC REFERENCE CENTER, JULY 2000.





UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY  
DIVISION OF SOLID AND HAZARDOUS WASTE

FIGURE 2-1  
SITE LOCATION MAP



TETRA TECH EM INC.

### **2.1.2 History and Operations**

The area where DCD is now located was used for grazing and agriculture prior to its use as a military installation. Construction and development at DCD began in 1942 when approximately 15,170 acres were transferred to the U.S. Army; another 4,196 acres were acquired by direct purchase, and 2 acres were leased. The original mission at DCD was to provide storage and maintenance services for chemical munitions. During World War II, approximately 700 to 1,000 people worked at the depot, including guards, laborers, machinists, and administrative personnel. Some workers lived in neighboring towns, but DCD also provided housing and community facilities for the workers that lived on site.

After World War II, TEAD served as a chemical munition storage facility that staffed primarily maintenance and security personnel. In July 1950, DCD was reactivated for maintenance service, and in May of 1955, TEAD assumed control of DCD. In 1962, DCD became known as TEAD-South, and in 1977, all of the chemical munitions at TEAD were transferred to the Area 10 Storage facility at TEAD-South.

In September 1979, CAMDS was constructed as a pilot facility to test chemical munition demilitarization methods. CAMDS was a tenant at DCD until 1999 when CAMDS became part of DCD. CAMDS continues to research alternative methods for the demilitarization of chemical munitions.

Between 1990 and 1993, TOCDF was constructed as an incineration facility designed to demilitarize the chemical munitions stockpile stored at TEAD-South. TOCDF operations began in 1996. In 1997, the Army reassigned DCD as an independent installation no longer under the direction of TEAD. The name of the installation switched from TEAD-South to DCD. DCD currently consists of 114 administrative and operations buildings, 209 igloos, 42 miles of railroad tracks, 48 miles of paved roads, and 30 miles of unpaved roads.

### **2.1.3 Resource Conservation and Recovery Act-Regulated Activities at DCD**

The following sections provide brief descriptions of the RCRA-regulated activities at DCD. RCRA-regulated activities include operations at TOCDF, CAMDS, the Area 10 Storage facility, and the RRS.



### **2.1.3.1 Tooele Chemical Agent Disposal Facility**

TOCDF is a multi-furnace incineration facility used to demilitarize chemical agents and munitions stored at DCD. The facility is a tenant of DCD and is government owned. TOCDF is contractor operated by EG&G Inc. Hazardous waste activities conducted at TOCDF include treatment by incineration, storage and treatment in tanks, and treatment by separation of munitions components. The TOCDF RCRA Permit, issued in 1989, includes requirements for waste analysis, air monitoring, training, security, emergency response, pollution prevention, design, construction, and operation of TOCDF (DSHW 1989). Following the issuance of the RCRA permit, TOCDF was constructed between 1990 and 1993. TOCDF operations involving the demilitarization of chemical agents and munitions began in 1996. Operation of TOCDF is expected to end in 2004.

Operations at TOCDF are conducted in “campaigns.” Campaigns are conducted to complete the destruction of all munitions for a specific agent prior to beginning the destruction of the other agent munitions. Multiple types of munitions containing the same agent may be processed at the same time. The first agent campaign at TOCDF is the GB campaign. This will be followed by the VX and H campaigns. Additional trial burn tests will be conducted at the TOCDF facility before beginning both the VX and H munition campaigns.

As of September 3, 2000, TOCDF has processed about 4,669 tons of the approximately 6,050 tons of original GB agent stockpiled (about 77 percent) or 34.2 percent of the approximately 13,616 tons of original total agent stockpiled (see Table 2-1) (Program Manager for Chemical Demilitarization [PMCD] 2000). This includes the destruction of 505,402 GB 105MM projectiles; 4,819 GB ton containers; 4,463 GB 750-pound bombs; and 25,679 GB M55 rockets.

Section 2.2 describes the emission sources at TOCDF that will be evaluated in the HHRA.

### **2.1.3.2 Chemical Agent Munitions Disposal System**

CAMDS began operation in September 1979 as a research activity designed to develop methods and procedures—primarily employing various types of incineration—to destroy chemical munitions stockpiled at DCD and other U.S. Army depot locations such as Johnston Atoll, Umatilla Army Depot, and Pine Bluff Arsenal. From May 31, 1991, until 1996, CAMDS operated under a research, development, and demonstration (RD&D) permit issued by DSHW (Redcon 1991). The RD&D permit was modified at least three times—on April 5, 1993; March 15, 1995; and May 26, 1995.

On June 26, 1996, DSHW issued a compliance order regarding the RD&D permit (DSHW 1996). The compliance order included two new RD&D permits: one allowed CAMDS to perform a ton container heel test on the metal parts furnace (MPF); the other allowed CAMDS to operate material decontamination chamber 2. Feed was limited to the chemical agents included in the original RD&D permit as well as spent decontamination solution and brine. On July 1, 1996, CAMDS submitted Part B of a RCRA permit application to DSHW for the MPF, the liquid incinerator (LIC), and the deactivation furnace system (DFS) (CAMDS 1996). The RCRA Part B permit application was submitted in response to the June 26, 1996, compliance order.

On September 3, 1998, DSHW issued another compliance order regarding the RD&D permit (DSHW 1998). The compliance order allowed further testing and operation of the MPF to obtain data necessary to resolve data gaps in the RCRA Part B permit application. The facility was also ordered to cease and desist operation of the brine evaporator and drum dryer until the RCRA permit was issued.

In April 1999, DSHW issued a RCRA permit for a Lewisite neutralization system associated with Alternative Chemicals Weapons Assessment (ACWA) activities (DSHW 1999a). In September 1999, DSHW issued a RCRA permit for the MPF and LIC (DSHW 1999b). Since the RCRA Part B permit application was submitted, the facility has processed only nonhazardous wastes in the MPF; the LIC and DFS are currently nonoperational. It should be noted that because the RD & D and RCRA permits do not limit the number of days per year the systems at CAMDS can be operated, the HHRA conservatively assumes continuously operations at CAMDS (24 hours per day, 365 days per year) even though the systems are currently operated only intermittently.

CAMDS anticipates that the MPF will be used in the future to destroy off-specification VX-hydrolysate, pretreated ton containers that previously contained lewisite, and empty ton containers. The MPF may also be used to treat debris from ACWA support work and ACWA research and development debris. These activities are consistent with operations before treatment of hazardous waste was halted by the AWFCO limits set forth in the September 3, 1998, compliance order.

CAMDS also anticipates a new mission. In 1985, the U.S. Congress directed the U.S. Army to destroy its stockpile of chemical weapons, of which almost 50 percent are stored at DCD. Currently, stockpile destruction is conducted at the TOCDF, a separate incineration complex at DCD. Facility personnel have indicated that CAMDS will be used in the future to destroy stockpiles of VX munitions stored at DCD.

Section 2.2 describes the emission sources at CAMDS that will be evaluated in the HHRA.

### **2.1.3.3 Hazardous Waste Storage Activities**

RCRA-permitted hazardous waste is stored throughout DCD. DCD's RCRA Permit was issued in 1993 (DSHW 1993). The largest of these hazardous waste storage units is the Area 10 Storage facility. Located in a secured area adjacent to TOCDF, chemical munitions stored here consist of bombs, rockets, spray tanks, and artillery projectiles, which are stored with and without their explosive components in earth-covered igloos.

The RCRA permit allows varying quantities of hazardous waste to be stored at the following areas at DCD, including Area 10 and the CAMDS facility (DSHW 1993):

#### **Area 10 Storage**

- 27 M-55 Rocket Storage Igloos—container storage of up to 397,494 gallons of wastes with free liquids
- 7 Chemical Munition Storage Igloos—container storage of up to 147,840 gallons of wastes with free liquids

#### **South Area Storage**

- Building 4536—container storage of up to 83,160 gallons of wastes without free liquids



### **Area 2 Storage**

- Building 4104—container storage of up to 11,880 gallons of wastes with free liquids
- Building 4105—container storage of up to 83,600 gallons of wastes without free liquids

### **Open Burning/Open Detonation Area**

- Conex—container storage of up to 440 gallons of wastes without free liquids

### **CAMDS Storage**

- Equipment Test Facility—container storage of up to 40,260 gallons of wastes with free liquids
- Munitions Holding Area Igloo—container storage of up to 4,040 gallons of wastes with free liquids
- Metal Parts Furnace—container storage of up to 17,160 gallons of wastes with free liquids
- Residual Storage Area—container storage of up to 6,600 gallons of wastes with free liquids
- Segregator/Explosive Containment Cubicle #1—container storage of up to 5,280 gallons of wastes with free liquids
- Toxic Dunnage Incinerator—container storage of up to 4,400 gallons of wastes with free liquids
- Toxic Maintenance Facility—container storage of up to 6,600 gallons of wastes with free liquids

Wastes stored in these areas contain RCRA wastes with codes D001, D002, D003, D004, D005, D006, D007, D008, D009, D011, D037, F001, F002, F003, F004, F005, F999, and P999.

It is anticipated that hazardous waste storage activities will continue at least until all chemical munition stockpile activities are completed at TOCDF and CAMDS.

Section 2.2 describes the hazardous waste storage emission sources at DCD that will be evaluated in the HHRA.

#### **2.1.3.4 Rapid Response System**

The RRS operates inside Building 4553 at DCD. The RRS is designed to process chemical agent identification sets (CAIS) items—typically contained in glass ampules or bottles—that are currently stored in steel cylinders at the Area 10 Storage facility. The treatment process includes three main steps: (1) removing the CAIS vials from overpack containers and other packing material, (2) mixing the agent with excess amounts of decontamination solution and treating the agent in a treatment vessel, and (3) sampling and analyzing the waste to determine if treatment is complete (DSHW 2000a). CAIS items may contain HD, bis(2-chloroethyl)ethylamine (HN-1), tri(2-chloroethyl)amine (HN-3), and lewisite (L). CAIS kits may also contain PS (chloropicrin in chloroform), CG (phosgene), CK (cyanogen chloride), GA Simulant, PS on charcoal, CN (chloractophenone), DM (Adamsite), and triphosgene (a CG simulant). A complete list of compounds that may be treated in the RRS may be found in the RRS Treatment Permit (DSHW 2000a). Waste residues generated during the treatment process may contain chemical agent at concentrations up to 50 mg/L and may contain metals and other RCRA constituents. Following treatment, this waste is characterized before being sent to an off-site hazardous waste incineration facility.

The RRS is permitted to operate under a hazardous waste treatment permit that was originally issued on December 22, 1998. Although the RRS was designed as a mobile system only, it allows CAIS items to be treated in Building 4553 at DCD (DSHW 2000a). The RRS is permitted to treat a maximum of 132 milliliters of waste per reactor batch every 15 minutes. It is anticipated that the RRS will treat CAIS items for only 6 months.

Section 2.2 describes the emission sources at RRS that will be evaluated in the HHRA.

## **2.2 EMISSION SOURCES AND AVAILABLE STACK GAS EMISSION RATE DATA**

The HHRA will evaluate the risks from all emission sources at each of the four RCRA-regulated activities at DCD. The following sections describe each emission source and the stack gas emission rate data that is available for TOCDF, CAMDS, the various hazardous waste storage areas, and the RRS. Due to (1) the lack of a complete set of data for all of the emission sources at DCD and (2) the similarity of the CAMDS, JACADS, and TOCDF incineration systems, this section and the emission estimates calculated in Section 2.4 include the use of data from other facilities in lieu of actual trial burn test data

for specific furnaces treating specific agents. Tables 2-2 through 2-10 are included to help demonstrate the similarity of the agents and munitions to be treated by the various systems, including the maximum permissible feed rate limits. Additional detailed comparisons of each furnace are presented in the various subsections of Section 2.4 where data extrapolation from one furnace to another is described.

### **2.2.1 TOCDF Emission Sources**

The design and operation of TOCDF is based on the design and operation of the JACADS. The demilitarization process at TOCDF involves three major steps: (1) handling and transferring chemical munitions from the Area 10 Storage facility to TOCDF, (2) disassembling and incinerating chemical munitions and agents, and (3) managing the waste materials that remain after incineration (DSHW 1989). These activities are generally carried out in four separate areas of the TOCDF: (1) the container handling building (CHB), (2) the munitions demilitarization building (MDB), (3) the pollution abatement system (PAS) building, and (4) the process utilities building (PUB).

Chemical munitions and agents transferred from the Area 10 Storage facility are typically unloaded at the CHB. Disassembly and incineration activities are conducted in the MDB. The MDB houses four different incinerators: the MPF, the deactivation furnace system, and LICs (LIC1 and LIC2) (see Sections 2.2.1.1 through 2.2.1.3). The LICs may operate at the same time as either the MPF or DFS; however, the MPF and the DFS do not typically operate at the same time.

Both the CHB and the MDB are kept under negative pressure by the heating, ventilation, and air conditioning (HVAC) system (see Section 2.2.1.4) to prevent fugitive emissions. Process vessels in the PAS building and PUB are kept under significant negative pressure and fugitive emissions from the systems are not expected in these buildings. Therefore, an evaluation of potential fugitive emission sources separate from the evaluation of the TOCDF HVAC was conducted.

Emissions from each incinerator are treated by a separate pollution abatement system in the PAS building, before venting to a common stack. PAS byproducts (brines) are treated in the brine reduction area (BRA). The BRA, except for the BRA burner and baghouses (see Section 2.2.1.5), is located inside the PUB. The HVAC filter system and BRA have separate stacks.

TABLE 2-2

**CAMDS METAL PARTS FURNACE PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

Munition	Model	Maximum Munitions per Tray <sup>a</sup>	Interval Between Tray Feed (minutes)	Agent	Maximum Feed Rate (Pounds/Charge) <sup>a</sup>
Ton Container	NA	NA	NA	GA	Not permitted
Ton Container	NA	1	See note (b)	GB	130
Ton Container	NA	NA	NA	L	Not permitted
Ton Container	NA	1	See note (b)	H, HD, HT	130
Ton Container	NA	1	See note (b)	VX	45
Spray Tank	TMU-28	1	See note (b)	VX	45
Spray Tank	TMU-28/B	1	See note (b)	VX	45
750 Pound Bombs	MC1	1	See note (b)	GB	19
Wet Eye Bombs	MK-116	1	See note (b)	GB	30
155 mm Projectile	M104	48	See note (b)	H	24.9
155 mm Projectile	M110	48	See note (b)	H	24.9
155 mm Projectile	M121	48	See note (b)	GB	24.9
155 mm Projectile	M121A1	48	See note (b)	GB	24.9
155 mm Projectile	M121A1	48	See note (b)	VX	12.8
155 mm Projectile	M122	48	See note (b)	GB	24.9
105 M Projectile	M360	75	See note (b)	GB	9.3
8 Inch Projectile	M426	27	See note (b)	GB	33.9
8 Inch Projectile	M426	27	See note (b)	VX	19.6
4.2 Inch Mortar	M2	75	See note (b)	HD	45
4.2 Inch Mortar	M2	75	See note (b)	HT	45
4.2 Inch Mortar	M2A	75	See note (b)	HT	45
4.2 Inch Mortar	M2A	75	See note (b)	HD	45
Agent contaminated liquid wastes	NA	NA	See note (c)	ALL	130
Dunnage/Charcoal/DPE/Spent Decontamination Solution	NA	NA	See note (c)	ALL	130
Fuel Oil, Hydraulic Oil, Hydraulic Fluid, and Water-Glycol Solution (non-munitions waste)	NA	NA	See note (c)	ALL	200
Waste Metal (non-munitions wastes)	NA	NA	See note (c)	ALL	200

## Notes:

ALL All agents (GB, VX, and mustard)  
 DPE Demilitarization Protective Ensemble  
 DSHW Division of Solid and Hazardous Waste  
 MPF Metal Parts Furnace  
 NA Not applicable

- a The feed rate of chlorine to the MPF shall not exceed 75 pounds per hour.  
 b The 1999 RCRA permit established feed charge intervals of 86 minutes for GB, 80 minutes for VX, 80 minutes for mustard compounds, and 80 minutes for non-munitions wastes.  
 c Batch feed only; feed interval is no less than 80-minutes.

Source: DSHW 1999b

**TABLE 2-3**

**TOCDF METAL PARTS FURNACE PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

<b>Munition</b>	<b>Model</b>	<b>Maximum Munitions per Tray<sup>a</sup></b>	<b>Interval Between Tray Feed (minutes)</b>	<b>Agent</b>	<b>Maximum Feed Rate (Pounds/Charge)<sup>a</sup></b>
Ton Container	NA	NA	NA	GA	Not permitted
Ton Container	NA	1	35	GB	75
Ton Container	NA	NA	NA	L	Not permitted
Ton Container	NA	1	35	H, HD, HT	90
Ton Container	NA	1	35	VX	75
Spray Tank	TMU-28	1	60	VX	67.8
Spray Tank	TMU-28/B	1	60	VX	67.8
750 Pound Bombs	MC1	2	20	GB	22
Wet Eye Bombs	MK-116	1	30	GB	17.4
155 mm Projectile	M104	48	20	H	28.1
155 mm Projectile	M110	48	20	H	28.1
155 mm Projectile	M121	48	20	GB	15.6
155 mm Projectile	M121A1	48	20	GB	15.6
155 mm Projectile	M121A1	48	20	VX	14.4
155 mm Projectile	M122	48	20	GB	15.6
105 M Projectile	M360	96	20	GB	7.8
8 Inch Projectile	M426	NA	NA	GB	Not permitted
8 Inch Projectile	M426	NA	NA	VX	Not permitted
4.2 Inch Mortar	M2	96	20	H, HD, HT	27.8
4.2 Inch Mortar	M2A	96	20	H, HD, HT	28.8
Mine Drums	M23	24	20	VX	12.6
Agent contaminated wastes	NA	NA	20	ALL	200

Notes:

ALL All agents (GB, VX, and mustard)  
DSHW Division of Solid and Hazardous Waste  
NA Not applicable

a The feed rate of chlorine to the MPF shall not exceed 75 pounds per hour.

Source: DSHW 1999b

**TABLE 2-4**

**JACADS METAL PARTS FURNACE PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

<b>Munition</b>	<b>Model</b>	<b>Maximum Munitions per Tray</b>	<b>Interval Between Tray Feed (minutes)</b>	<b>Agent</b>	<b>Maximum Feed Rate (Pounds/Charge)<sup>a</sup></b>
Ton Container	NA	U	U	GA	U
Ton Container <sup>a</sup>	NA	U	U	GB	U
Ton Container	NA	U	U	L	U
Ton Container <sup>a</sup>	NA	U	U	H, HD, HT	U
Ton Container <sup>a</sup>	NA	U	U	VX	U
Spray Tank	TMU-28	U	U	VX	U
Spray Tank	TMU-28/B	U	U	VX	U
750 Pound Bombs <sup>a</sup>	MC1	U	U	GB	U
Wet Eye Bombs	MK-116	U	U	GB	U
MK94 Bombs <sup>a</sup>	MK94	U	U	U	U
155 mm Projectile <sup>a</sup>	M104	U	U	H	U
155 mm Projectile <sup>a</sup>	M110	U	U	H	U
155 mm Projectile <sup>a</sup>	M121	U	U	GB	U
155 mm Projectile <sup>a</sup>	M121A1	U	U	GB	U
155 mm Projectile <sup>a</sup>	M121A1	U	U	VX	U
155 mm Projectile <sup>a</sup>	M122	U	U	GB	U
105 M Projectile <sup>a</sup>	M360	U	U	GB	U
105 M Projectile <sup>a</sup>	M360	U	U	HD	U
8 Inch Projectile <sup>a</sup>	M426	27	26.1	GB	19.6
8 Inch Projectile <sup>a</sup>	M426	U	U	VX	U
M60 Projectiles <sup>a</sup>	M60	U	U	HD	U
4.2 Inch Mortar <sup>a</sup>	M2	U	U	H, HD, HT	U
4.2 Inch Mortar	M2A	U	U	H, HD, HT	U
M55 Rockets <sup>a</sup>	M55	U	U	U	U
Mine Drums <sup>a</sup>	M23	U	U	VX	U
Agent contaminated wastes	NA	U	U	ALL	U

Notes:

ALL All agents (GB, VX, and mustard)  
 NA Not applicable  
 PMCD Program Manager for Chemical Demilitarization  
 U Unknown at this time

a The munitions are in the JACAD inventory

Source: PMCD 1998; 2000



**TABLE 2-5**

**CAMDS DEACTIVATION FURNACE PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

Munition	Model	Maximum Units per Hour	Maximum Feed Rate (lb/hr)		
			Feed Rate (Agent)	Explosives	Propellant
GB Rockets <sup>a</sup>	M55	25	268 (GB)	80	482.5
VX Rockets <sup>a</sup>	M55	25	250 (VX)	80	482.5
VX Mine <sup>a</sup>	M23	60	630 (VX)	60	NA
105 mm Projectile <sup>a</sup>	M360	60	60 (GB)	NA	NA
105 mm CART <sup>a</sup>	M60	25	75 (HD)	7	7.5
155 mm Projectile <sup>a</sup>	M110	40	468 (H)	16.4	NA
155 mm Projectile <sup>a</sup>	M104	40	468 (H)	16.4	NA
155 mm Projectile <sup>a</sup>	M121	40	260 (GB)	98	NA
155 mm Projectile <sup>a</sup>	M121A	40	260 (GB)	98	NA
155 mm Projectile <sup>a</sup>	M121A1	40	240 (VX)	98	NA
155 mm Projectile <sup>a</sup>	M122	40	260 (GB)	98	NA
8 Inch Projectile <sup>a</sup>	M426	30	435 (GB)	216	NA
8 Inch Projectile <sup>a</sup>	M426	30	435 (VX)	216	NA
4.2 Inch Mortar <sup>a</sup>	M2	60	360 (H)	48	NA
4.2 Inch Mortar <sup>a</sup>	M2	60	348 (H)	48	NA
Spent Decontamination Solution <sup>a</sup>	NA	600	ALL	NA	NA
Bulk Feed <sup>a</sup>	NA	NA	280 (H, HD, HT)	NA	NA
Bulk Feed <sup>a</sup>	NA	NA	150 (VX)	NA	NA
Dungaree	NA	NA	650	NA	NA

Notes:

ALL All agents (GB, VX, and mustard)

NA Not applicable

<sup>a</sup> The feed rate of chlorine shall not exceed 180 lb/hour based on agent feed rates.

Source: Redcon 1991.

**TABLE 2-6a**

**TOCDF DEACTIVATION FURNACE PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

Munition	Model	Maximum Units per Hour	Maximum Feed Rate (lb/hr)		
			Feed Rate (Agent)	Explosives	Propellant
GB Rockets <sup>a</sup>	M55	33	17.0 (GB)	105.6	636.9
VX Rockets <sup>a</sup>	M55	38	19.0 (VX)	121.6	7.33.4
VX Mine <sup>a</sup>	M25	70	36.8 (VX)	56	NA
105 mm Projectile	M360	287.6	NA	322.1	NA
155 mm Projectile	M110	276	NA	113.2	NA
155 mm Projectile	M104	276	NA	113.2	NA
155 mm Projectile	M121A1	120	NA	294	NA
155 mm Projectile	M122	120	NA	294	NA
8 Inch Projectile	M426	47	NA	329	NA
4.2 Inch Mortar	M2	274	NA	38.4	109.6
4.2 Inch Mortar	M2A1	274	NA	38.4	109.6

Notes:

DSHW Division of Solid and Hazardous Waste

NA Not applicable

a The feed rate of chlorine shall not exceed 6.4 lb/hour based on agent feed rates.

Source: DSHW 1989.

**TABLE 2-6b**

**TOCDF DEACTIVATION FURNACE PERMITTED WASTE FEEDS  
FOR COMBINED M55 ROCKETS AND GB PROJECTILE COMPONENTS**

Munition	Model	Maximum Units per Hour	Maximum Feed Rate (lb/hr)		
			Feed Rate (Agent)	Explosives	Propellant
Gelled GB Rockets <sup>a</sup>	M55	1	10.7 (GB)	3.2	19.3
105 mm Projectile	M360	88	19.0 (VX)	100.8	NA

Notes:

DSHW Division of Solid and Hazardous Waste

NA Not applicable

a The feed rate of chlorine shall not exceed 6.4 lb/hour based on agent feed rates.

Source: DSHW 1989.

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TABLE 2-7

**JACADS DEACTIVATION FURNACE PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

Munition	Model	Maximum Units per Hour	Maximum Feed Rate (lb/hr)		
			Feed Rate (Agent)	Explosives	Propellant
GB Rockets <sup>a</sup>	M55	U	U	U	U
VX Rockets <sup>a</sup>	M55	U	U	U	U
VX Mine <sup>a</sup>	M23	U	U	U	U
105 mm Projectile <sup>a</sup>	M360	U	U	U	U
105 mm CART <sup>a</sup>	M60	U	U	U	U
155 mm Projectile <sup>a</sup>	M110	U	U	U	U
155 mm Projectile <sup>a</sup>	M104	U	U	U	U
155 mm Projectile <sup>a</sup>	M121	U	U	U	U
155 mm Projectile <sup>a</sup>	M121A	U	U	U	U
155 mm Projectile <sup>a</sup>	M121A1	U	U	U	U
155 mm Projectile <sup>a</sup>	M122	U	U	U	U
8 Inch Projectile <sup>a</sup>	M426	47	NA	329 (Comp B) 14.1 (TNT)	NA
8 Inch Projectile <sup>a</sup>	M426	47	NA	329 (Comp B) 14.1 (TNT)	NA
4.2 Inch Mortar <sup>a</sup>	M2	U	U	U	U
4.2 Inch Mortar <sup>a</sup>	M2	U	U	U	U
Spent Decontamination Solution <sup>a</sup>	NA	U	U	U	U
Bulk Feed <sup>a</sup>	NA	U	U	U	U
Bulk Feed <sup>a</sup>	NA	U	U	U	U
Dungaree	NA	U	U	U	U

Notes:

ALL All agents (GB, VX, and mustard)

NA Not applicable

U Unknown at this time

a The feed rate of chlorine shall not exceed 180 lb/hour based on agent feed rates.

**TABLE 2-8**

**CAMDS LIC PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

<b>Hazardous Waste/Agent</b>	<b>Agent</b>	<b>Maximum Feed Rate to the PCC (lb/hr)</b>	<b>Maximum Feed Rate to the SCC (lb/hr)</b>
GB	Same	300	0
VX	Same	240	0
Mustard (H, HD, HT)	Same	300	0
Surrogate Materials	NA	380	0
Decontamination Solutions	ALL	0	120
Agent Contaminated Liquid Wastes <sup>a</sup>	ALL	120	0

Notes:

ALL All agents (GB, VX, mustard)  
NA Not applicable  
PCC Primary combustion chamber  
SCC Secondary combustion chamber

Source: DSHW 1999b.

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**TABLE 2-9**

**TOCDF LIC PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

<b>Hazardous Waste/Agent</b>	<b>Agent</b>	<b>Maximum Feed Rate to the PCC (lb/hr)</b>	<b>Maximum Feed Rate to the SCC (lb/hr)</b>
GB <sup>a</sup>	Same	833	NA
VX <sup>a</sup>	Same	580	NA
Mustard (H, HD, HT) <sup>a</sup>	Same	1,160	NA
Surrogate Materials	NA	NA	NA
Agent Contaminated Liquid Wastes <sup>a</sup>	GB	833	833
Agent Contaminated Liquid Wastes <sup>a</sup>	VX	580	580
Agent Contaminated Liquid Wastes <sup>a</sup>	Mustard (H, HD, HT)	1,160	1,160
Decontamination Solutions	ALL	1,790	1,790

Notes:

ALL All agents (GB, VX, and mustard)  
DSHW Division of Solid and Hazardous Waste  
NA Not applicable  
PCC Primary combustion chamber  
SCC Secondary combustion chamber

a The feed rate of chlorine shall not exceed 445 lb/hour.

Source: DSHW 1989.



**TABLE 2-10****JACADS LIC PERMITTED WASTE FEEDS  
AND FEED RATE LIMITS**

<b>Hazardous Waste/Agent</b>	<b>Agent</b>	<b>Maximum Feed Rate to the PCC (lb/hr)</b>	<b>Maximum Feed Rate to the SCC (lb/hr)</b>
GB	Same	750	NA
VX	Same	1,076	NA
Mustard (H, HD, HT)	Same	699	NA
Surrogate Materials	NA	NA	NA
Agent Contaminated Liquid Wastes	GB	750	833
Agent Contaminated Liquid Wastes	VX	1,076	580
Agent Contaminated Liquid Wastes	Mustard (H, HD, HT)	699	1,160
Decontamination Solutions	ALL	U	U

Notes:

ALL All agents (GB, VX, and mustard)  
 NA Not applicable  
 PCC Primary combustion chamber  
 SCC Secondary combustion chamber  
 U Unknown at this time

Source: Feed rates shown are the average of waste feed rates from trial burn tests as follows:

GB: SRI 1991  
 VX: SRI 1992b  
 Mustard: SRI 1992c

The following subsections describe the LICs, MPF, DFS, HVAC, and BRA at TOCDF.

#### **2.2.1.1 TOCDF Liquid Incinerators 1 and 2**

The TOCDF LICs are used to destroy liquid chemical agent drained from chemical munitions in the MDB as well as spent decontamination solution (SDS) generated in the MDB (SDS generally consists of highly concentrated sodium hydroxide and sodium hypochlorite). Chemical agent is drained from the munitions by pumping the agent to the Agent Quantification System (AQS) and then to the Agent Collection System (ACS) tanks. The ACS tanks serve as feed tanks for TOCDF LIC1 and TOCDF LIC2. SDS is collected in sumps that drain to the SDS tanks, which also serve as feed tanks for the TOCDF LIC1 and TOCDF LIC2.

Both TOCDF LIC1 and TOCDF LIC2 consist of three main subsystems, including a primary combustion system, an afterburner, and PAS (DSHW 1989). Process operating conditions are controlled by programmable logic controllers (PLC), and operating parameters are electronically recorded by a process data acquisition and recording system (PDARS). At both TOCDF and JACADS, the LIC consists of an agent supply and feed system, a primary combustion chamber, a crossover duct, and a secondary combustion chamber. The LIC at the TOCDF uses natural gas for auxiliary fuel, with agent being the primary fuel. The auxiliary fuel for the JACADS LIC is JP-5, and agent is the primary fuel. The PAS at TOCDF and JACADS consist of the same components in the same order, with slight differences in size and capacity.

Emission rate data for the trial burn test stack are available for TOCDF LIC1 and TOCDF LIC2 while treating the chemical agent GB (EG&G 1997b; 1998b). Trial burn tests for the TOCDF LICs while treating other chemical agents have not been conducted. Due to (1) the similarity of the TOCDF LICs and the JACADS LICs, (2) the lack of trial burn test data for the TOCDF LICs while treating chemical agents VX and H, and (3) the lack of trial burn test data from any other similar facility (such as CAMDS); trial burn test data for the JACADS LICs while treating chemical agents VX and H (SRI 1992b; 1992c) will be used to estimate the stack gas emission rates for the TOCDF LICs while treating these agents. Section 2.4 describes the derivation of stack gas emission rate estimates for the HHRA for the TOCDF LICs.

### **2.2.1.2 TOCDF Metal Parts Furnace**

The TOCDF MPF is used to treat the metal components of chemical munitions after the bulk of the chemical agent that they contained is removed. These components include empty ton containers, empty spray containers, and bomb, mine, mortar, and projectile shells. The TOCDF MPF consists of three subsystems, including a primary combustion system, an afterburner, and PAS (DSHW 1989). Process operating conditions are controlled by PLCs, and the operating parameters are electronically recorded by the PDARS.

Chemical munitions treated in the TOCDF MPF are punched and drained, and then fed to the TOCDF MPF. Chemical agent is drained from the munitions by pumping the agent to the AQS and then to the ACS tanks. The AQS measures the amount of agent drained from the rocket, and the PLC calculates the amount of remaining agent before the rocket is fed into the TOCDF MPF.

TOCDF, CAMDS, and JACADS all contain similar MPF systems. A comparison of the various operating parameters is presented in Table 2-11. At each facility, the MPF processing system includes a direct-fired, two-chamber, roller hearth furnace; a secondary combustion chamber; a quench tower; a variable-throat venturi scrubber; a packed bed scrubber; a demister vessel; a prime mover with exhaust duct; a bulk item loading system; and a scrap handling and cooling equipment. The MPF PAS is designed to remove particulate and chemical pollutants from the flue gases.

One key difference between the MPFs, aside from the obvious differences in size and processing capabilities, is that the PCC of the TOCDF and JACADS furnaces contain three zones, while the CAMDS MPF PCC has two zones. The operating conditions of the TOCDF and JACADS MPFs are similar, with temperatures typically between 1,200 °F and 1,750 °F, and a required PCC draft greater than zero. The CAMDS MPF PCC and SCC are permitted to operate in a broader temperature range, likely due to a consequence of the smaller PCC volume. The additional chamber in the TOCDF and JACADS units allows for greater off-gas volume and residence time in burning out wastes, which allows these units to process more wastes than the CAMDS unit.

TABLE 2-11

## MPF ENGINEERING DATA

Component	TOCDF	CAMDS	JACADS
PCC Zones	3	2	3
PCC Temperature	1,200 to 1,700 °F	950 to 1,750 °F	1,450 to 1,750 °F, 1,600°F typical
PCC Pressure	< -0.1 inches water column	< -0.1 inches water column	< -0.1 inches water column -2.70 inches water column, typical
SCC Temperature	1,800 to 2,175 °F	1,450 to 2,175 °F	1,900 to 2,250 °F 2,000 °F typical
SCC Residence Time	>0.5 seconds	>1.0 seconds	U
Auxiliary Fuel	Natural gas	Natural gas	JP-5
Quench Tower Exhaust Temperature	<225 °F	U	U
Venturi Exit Temperature	U	>190 °F	U
Venturi Pressure Drop	>20 in w.c.	>20 inches water column 40 inches water column, design 15 to 45 inches water column, typical	12 to 50 inches water column, 14.9 inches water column, typical
Venturi Design Gas Flow Rate	U	6,917 acfm	U
Venturi Brine Flow	>50 gpm 50 to 150 gpm typical	>30 gpm	120 gpm, typical
Packed Bed Scrubber (PBS) Pressure Drop	1 to 10 inches water column	U	1 to 10 inches water column, 3 inches water column, typical
PBS Clean Liquor Flow Rate	>400 gpm, 400 to 900 gpm typical	150 gpm	>395 gpm
PBS Brine Flow Rate	U	>150 gpm	U
PBS Liquor pH	≥ 7.0	≥ 7.0	≥ 7.0
PBS Design Gas Flow Rate	U	16,100	U
Demister Elements (number)	Candles	Candles	Candles (16)
Demister Efficiency	95 percent	95 percent	95 percent
ID Fan	U	300 HP 15,400 acfm at 68 inches water column and 154°F	Up to 66 inches water column at maximum gas flow rate
Stack Gas Oxygen	3 to 15 percent	3 to 15 percent	2.5 to 14 percent
Stack Gas Carbon Monoxide	<100 ppmv	<100 ppmv	<100 ppmv
Stack Gas Flow Rate	<1.2 inches water column	6,500 to 13,500 acfm; 10,000 scfm	2,671 dscfm

Notes:

acfm	Actual cubic feet per minute
CAMDS	Chemical Agent Munitions Disposal System
dscfm	Dry standard cubic feet per minute
gpm	Gallon per minute
HP	Horsepower
JACADS	Johnston Atoll Chemical Agent Disposal System
PCC	Primary combustion chamber
ppmv	Parts per million dry volume
SCC	Secondary combustion chamber
scfm	Standard cubic feet per minute
TOCDF	Tooele Chemical Agent Disposal System
U	Unavailable

The venturi brine and packed bed scrubber clean liquor flow rates for the TOCDF MPF PAS and JACADS MPF PAS are very similar. However, the venturi brine and packed bed scrubber clean liquor flow rates of the CAMDS MPF PAS are significantly lower than flow rates of the TOCDF MPF PAS and JACADS MPF PAS, due to the smaller size of the CAMDS MPF. Unlike the JACADS and TOCDF MPF, the CAMDS MPF and LIC share the same PAS. The JACADS has a dedicated PAS, but shares a common stack with the LIC and DFS. Likewise, the TOCDF MPF shares a common stack with the LIC and DFS.

Trial burn test stack gas emission rate data are available for the TOCDF MPF while treating the chemical agent GB (EG&G 1997a). Trial burn tests for the TOCDF MPF while treating other chemical agents have not been conducted. Due to (1) the similarity of the TOCDF MPF and the JACADS MPF, (2) the lack of trial burn test data for the TOCDF MPF while treating chemical agent H, and (3) the lack of trial burn test data from any other similar facility (such as CAMDS) while treating chemical agent H; trial burn test data for the JACADS MPF while treating chemical agent H (SRI 1992d) will be used to estimate the stack gas emission rates for the TOCDF MPF while treating this agent. Due to (1) the similarity of the TOCDF MPF and the CAMDS MPF and (2) the lack of trial burn test data for the TOCDF MPF while treating chemical agent VX; trial burn test data for the CAMDS MPF while treating chemical agent VX (TRC 1994) will be used to estimate the stack gas emission rates for the TOCDF MPF while treating this agent. Section 2.4 describes the derivation of stack gas emission rate estimates for the TOCDF MPF.

#### **2.2.1.3 TOCDF Deactivation Furnace**

The TOCDF DFS is designed to treat chemical munitions containing energetic components (propellants, bursters, and explosives) after the bulk of the chemical agent that they contain is removed. These components include rockets, projectiles, and mines (DSHW 1989). The TOCDF DFS consists of four main subsystems: a rotary kiln (primary combustion), an explosion attenuation duct and cyclone, an afterburner, and a PAS.

Chemical munitions treated in the TOCDF DFS are punched and drained, and then chopped in the Explosive Containment Room before being fed to the TOCDF DFS. Chemical agent is drained from the munitions by pumping the agent to the AQS and then to the ACS tanks. The AQS measures the amount

of agent drained from the rocket, and the PLC calculates the amount of remaining agent before the rocket is fed into the TOCDF DFS.

The DFS at JACADS, TOCDF, and CAMDS share a common design, consisting of a feed chute with double tipping blast valves, a charge end subassembly, a rotary retort, a heated discharge conveyor, a scrap conveyor, a cyclone separator, a slagging afterburner, and a pollution abatement system. In addition to sharing most of the same design features, the TOCDF, CAMDS, and JACADS DFS PCC, SCC, and HDC operate at very similar temperatures, rotational speeds, and pressures. A summary of the operating parameters at each facility is presented in Table 2-12.

Due to differences in the scaling of the units, the CAMDS SCC has a 1 second minimum residence time, whereas the TOCDF SCC has a 2 second minimum residence time. The SCC residence time for the JACADS SCC appears to be similar to the TOCDF. The minimum temperature for the CAMDS DFS SCC is 1,400 °F, whereas the minimum SCC temperature for the TOCDF DFS and JACADS DFS is 2,050 and 1,500 °F, respectively, due to the smaller volume and lower thermal stability of the CAMDS DFS SCC. The TOCDF DFS PAS and JACADS DFS PAS also operate at comparable limits, but pressure drops and liquor flow rates are somewhat greater in the TOCDF DFS PAS than in the JACADS system. However, permitted feed rates are identical for 8-inch M426 projectiles.

The packed bed scrubber, clear liquor flow rate for the CAMDS DFS is a maximum of 300 gallons per minute (gpm), based on the pump sizing. The TOCDF DFS packed bed clear liquor flow rate is typically 750 to 2,400 gpm, whereas the JACADS DFS packed bed clear liquor flow is typically 1,150 gpm. These differences are due to the differences in the scaling of the units, since the components and their design is common to all DFS.

Unlike the JACADS and TOCDF MPF, the CAMDS MPF and LIC share the same PAS. The JACADS MPF has a dedicated PAS, but shares a common stack with the LIC and DFS. Likewise, the TOCDF MPF shares a common stack with the LIC and DFS.



TABLE 2-12

## DFS ENGINEERING DATA

Component	TOCDF	CAMDS	JACADS
PCC Temperature	850 to 1,650 °F	>900 to 1,850 °F	1,000 to 1,600 °F, 1,300 ± 300 °F typical
PCC Rotational Speed	0.33 to 2 RPM	0.5 to 2 RPM	Up to 2 RPM
PCC Pressure	<= -0.1 inches water column	<0 inches water column	<0, -1.0 inches water column, typical
Auxiliary Fuel	Natural gas	Natural gas	JP-5
HDC Residence Time	U	15 minutes, minimum	15 minutes, minimum
HDC Temperature	>1,000 °F	>1,000 °F	>1,000 °F
Cyclone Design Pressure Drop	U	2.3 inches water column	U
Cyclone Inlet Combustion Gas Velocity	U	11,000 acfm, design	U
Cyclone Design Inlet Combustion Gas Temperature	U	1,200 °F	U
SCC (1) Temperature/Residence Time	2,050 to 2,350 °F, 2 second residence time	>1,400 to 2,150 °F, >1 second residence time	1,850 to 2,150 °F, 2,000+/-150 °F typical
SCC (2) Residence Time		>1 second residence time	U
Stack Exit Oxygen	3 to 15 percent	U	6.0 to 14.0 percent 11 percent typical
Stack Exit Carbon Monoxide (hourly rolling average)	< 100 ppmdv	< 100 ppmdv	<=100 ppmdv, 17.9 ppmdv typical
Quench Tower Exit Temperature	<200°F	U	180°F typical
Venturi Scrubber Pressure Drop	>20 inches water column	40 inches water column (design)	5 to 50 inches water column 20.0 inches water column, typical
Venturi Design Gas Flow Rate	U	12,255 acfm	U
Venturi Scrubber Brine Flow Rate	>300 gpm	320 gpm, maximum	200 to 300 gpm, 220 gpm typical
Packed Bed Scrubber (PBS) Pressure Drop	U	U	1 to 10 inches water column 1.5 inches water column, typical
PBS Clean Liquor Flow Rate	>750 gpm, 750 to 2,400 gpm typical	300 gpm, maximum	≥395 gpm, 1,150 gpm typical
PBS Clean Liquor pH	≥ 7.0	≥ 7.0	≥ 7.0, 8.0 typical
PBS Brine pH	≥ 7.0	≥ 7.0	≥ 7.0, 8.5 typical
PBS Design Gas Flow Rate	U	12,600 acfm	U
Demister Element	Candles	Candles	Candles (20)
Demister Efficiency	95 percent	95 percent	95 percent
ID Fan	U	300 HP 15,400 acfm at 68 inches water column and 154 °F	U
Combustion Gas Velocity/Stack Gas Flow Rate	< 0.93 inches water column 10,500 dscfm typical	4,165 dscfm, typical	11,000 dscfm typical
Stack Exit Temperature	U	U	U

## Notes:

Acfm	Actual cubic feet per minute
Dscfm	Dry standard cubic foot per minute
Gpm	Gallons per minute
HP	Horsepower
PCC	Primary combustion chamber
ppmdv	Parts per million dry volume
RPM	Revolutions per minute
SCC	Secondary combustion chamber
U	Unavailable

Trial burn test stack gas emission rate data are available for TOCDF DFS while treating the chemical agent GB (EG&G 1998a; 1999a). Trial burn tests for the TOCDF DFS while treating other chemical agents have not been conducted.

Due to (1) the similarity of the TOCDF DFS and the CAMDS DFS and (2) the lack of trial burn test data for the TOCDF DFS while treating chemical agent VX; trial burn test data for the CAMDS DFS while treating chemical agent VX (TRC 1993) will be used to estimate the stack gas emission rates for the TOCDF DFS while treating this agent.

The TOCDF DFS is not permitted to treat HD. However, bursters from HD-filled projectiles are anticipated to be treated in the TOCDF DFS. No chemical agent is anticipated with the bursters, and no other HD related munitions are anticipated for treatment in the DFS. The bursters from HD-filled projectiles are similar to the bursters from GB-filled projectiles which will be treated at TOCDF. A JACADS DFS GB trial burn test (Raytheon 1998) was conducted while treating bursters from 8-inch projectiles representative of HD projectile bursters to be treated in the TOCDF DFS. Due to (1) the similarity of the TOCDF DFS and the JACADS DFS, (2) the lack of trial burn test data for the TOCDF DFS while treating chemical agent HD, and (3) the lack of trial burn test data from any other similar facility (such as CAMDS) while treating chemical agent HD; trial burn test data for the JACADS DFS while treating chemical agent GB (Raytheon 1998) will be used to estimate the stack gas emission rates for the TOCDF DFS while treating HD.

TOCDF DFS GB trial burn test data were considered to be representative worst-case emission rates for the treatment of HD projectile bursters in the TOCDF DFS, given the similarity of the bursters from the GB and HD projectiles. This consideration was made because the actual TOCDF DFS GB trial burn test data collected while treating M55 rockets was considered worst-case waste that would conservatively represent emission rates while treating GB projectile bursters. However, it was determined that the extrapolated emission rates from the JACADS DFS GB trial burn test (Raytheon 1998) were higher than the TOCDF DFS GB trial burn test emission rates (EG&G 1998a; 1999a; see Section 2.4.1.4).

Section 2.4 describes the derivation of stack gas emission rate estimates for the TOCDF DFS.

#### **2.2.1.4 TOCDF Brine Reduction Area**

The TOCDF BRA is designed to treat spent brines from the PAS (DSHW 1989). The TOCDF BRA consists of a series of three drum dryers, two evaporators, an afterburner, and a baghouse. The TOCDF BRA dries the spent brine to a salt, destroys any residual organic contamination in the afterburner, and captures particulate matter in the baghouse before the off-gas is emitted through a separate stack. The brine salt is disposed of off-site as a hazardous waste.

The TOCDF BRA is currently not in operation. An approved compliance test is required before the TOCDF BRA can be permitted for long-term operations (DSHW 2000b). An unapproved compliance test of the TOCDF BRA was completed in 1997 (EG&G 1997c). Section 2.4 describes the derivation of stack gas emission rate estimates for the TOCDF BRA.

#### **2.2.1.5 TOCDF Heating, Ventilation, and Air Conditioning Filter System**

The TOCDF HVAC system exhausts air from the CHB and MDB in order to (1) maintain a negative pressure inside each of these buildings and (2) contain any fugitive emissions (DSHW 1989). The TOCDF HVAC filter system consists of a series of activated carbon filters and high efficiency particulate air (HEPA) filters to control the emission of organic compounds and particulate matter before the off-gas is emitted through a single common stack. The stack is monitored by an automatic continuous emissions monitoring system (ACAMS) to provide near-real time detection of chemical agents.

No stack gas emission rate data is available for the TOCDF HVAC. Section 2.4 describes the derivation of stack gas emission rate estimates for the TOCDF HVAC.

### **2.2.2 CAMDS Emission Sources**

Originally designed and constructed as a research and development facility for chemical munitions demilitarization, the CAMDS is the prototype facility upon which other chemical munition incineration complexes are based (including JACADS and TOCDF). As described in Section 2.2.3.2 above, CAMDS has only operated intermittently in the last several years. However, a new mission is anticipated for CAMDS that includes the use of the CAMDS LIC, CAMDS MPF, and CAMDS DFS systems to assist

TOCDF in the chemical munition stockpile destruction program at DCD. The HHRA is based on the use of CAMDS in the completion of this mission (continuous operations).

The demilitarization process at CAMDS involves three major steps: (1) handling and transferring chemical munitions from the Area 10 Storage facility to CAMDS, (2) disassembly and incineration of chemical munitions and agents, and (3) management of the waste materials that remain after incineration (CAMDS 1996; 1999). At the CAMDS, the MPF and LIC are housed within the MPF Building Complex, which also includes the MPF, LIC, Multipurpose Demilitarization Machine, Multipurpose Demilitarization Facility, Bulk Item Facility, Residual Storage Area, and Central Decontamination Supply operations. These structures are all conjoined and share interior walls. Each area is independently ventilated by ducting leading to the filter farm, located within the East Utilities Building complex, east of the DFS Building Complex.

The DFS building complex is located in a separate building, to the east of the MPF Building Complex. The DFS Building Complex includes the DFS, Unpack Area, Explosive Containment Cubicle, Segregation Area, and Filter 18. Each area is independently ventilated by ducting leading to the filter farm, located within the East Utilities Building complex, east of the DFS building complex.

Chemical munitions and agents transferred from the Area 10 Storage facility are typically unloaded at the Unpack Area. Disassembly and incineration activities are conducted in both the MPF and DFS Building Complexes, which house the three different incinerators at CAMDS: the CAMDS MPF, the CAMDS DFS, and the CAMDS LIC (see Sections 2.2.2.1 through 2.2.2.3). The DFS may operate at the same time as either the MPF or LIC, but the MPF and the LIC can not operate at the same time (however, if one furnace is operating, the other furnace can be operate in a “standby” mode to maintain the furnace at a high temperature condition using natural gas).

The MPF and DFS Building Complexes are kept under negative pressure by the CAMDS HVAC system (see Section 2.2.2.4) to prevent fugitive emissions. Process vessels in the these buildings are kept under significant negative pressure, and fugitive emissions are not expected from the systems in these buildings. Therefore, a separate evaluation of potential fugitive emission sources was not conducted.

Emissions from the DFS are treated by a separate PAS, before venting to a separate stack. Emissions from the MPF and LIC are treated by a common PAS, before venting to a common stack. PAS byproducts (brines) are then collected for off-site disposal. The CAMDS BRA is not in operation.

The following subsections describe the LIC, MPF, DFS, and HVAC at CAMDS.

Please note that CAMDS has also supported the ACWA Program in evaluating alternative destruction methods (for example, neutralization and cryogenic methods). The potential risk from the activities associated with this program will be evaluated in the HHRA by completing the risk assessment for the other emission sources at CAMDS due to (1) the negligible and intermittent emission rate of potential COPCs from the processes involved in the ACWA Program and (2) the conservative nature of the emission rate estimates for the other furnaces at CAMDS (see Section 2.4).

#### **2.2.2.1 CAMDS Metal Parts Furnace**

The CAMDS MPF system consists of two primary combustion chambers, an afterburner, a PAS, a monitoring shroud, material handling systems, cooling stations, an air filtration system, and graphic control systems (TRC 1994). The munitions are processed through the primary combustion chamber, Zones 1 and 2. In Zone 1, the munitions are heated, and residual chemical agent is volatilized. The munitions are then transferred to Zone 2 where incineration is completed. After the munitions are removed from the furnace, they are monitored to ensure that incineration of all chemical agent has been completed. Emissions from the primary combustion chambers are directed to the afterburner, and subsequently to the PAS.

Chemical munitions treated in the CAMDS MPF are punched and drained, and then fed to the CAMDS MPF. Chemical agent is drained from the munitions by pumping the agent to the AQS and then to the ACS tanks. The AQS measures the amount of agent drained from the rocket, and the PLC calculates the amount of remaining agent before the rocket is fed into the CAMDS MPF.

Trial burn test stack gas emission rate data is available for CAMDS MPF while treating the chemical agents GB and VX (IT 1995; TRC 1994). Trial burn tests for the CAMDS MPF while treating other chemical agents have not been conducted. Due to (1) the similarity of the CAMDS MPF and the JACADS MPF, (2) the lack of trial burn test data for the CAMDS MPF while treating chemical agent H,

and (3) the lack of trial burn test data from any other similar facility (such as TOCDF) while treating chemical agent H; trial burn test data for the JACADS MPF while treating chemical agent H (SRI 1992d) will be used to estimate the stack gas emission rates for the CAMDS MPF while treating this agent. Section 2.4 describes the derivation of stack gas emission rate estimates for the CAMDS MPF.

#### **2.2.2.2 CAMDS Liquid Incinerator**

The CAMDS LIC system consists of a primary combustion chamber, a secondary combustion chamber, and a PAS that is shared with the CAMDS MPF (CAMDS 1996). The CAMDS LIC is used to treat bulk chemical agent drained from chemical munitions.

No stack gas emission rate data is available for the CAMDS LIC. Because the CAMDS LIC and CAMDS MPF cannot be operated at the same time, the potential risk from the CAMDS LIC will be evaluated in the HHRA by completing the risk assessment process for the CAMDS MPF. This issue is discussed in more detail in Section 2.4.

#### **2.2.2.3 CAMDS Deactivation Furnace**

The CAMDS DFS consists of four main subsystems: a rotary kiln (primary combustion), a blast attenuation duct and cyclone, an afterburner, and a PAS (CAMDS 1996).

Chemical munitions treated in the CAMDS DFS are punched and drained, and then chopped in the Explosive Containment Room before being fed to the CAMDS DFS. Chemical agent is drained from the munitions by pumping the agent to the AQS and then to the ACS tanks. The AQS measures the amount of agent drained from the rocket, and the PLC calculates the amount of agent that still remains in the rocket before it is fed into the CAMDS DFS.

Test burn stack gas emission rate data is available for CAMDS DFS while treating the chemical agents VX and HD (AT 1992a; 1992b; TRC 1993). Trial burn tests for the CAMDS DFS while treating chemical agent GB have not been conducted. Please note that the CAMDS DFS HD data (AT 1992a; 1992b) is not considered to be “trial burn test quality.” However, due to the lack of trial burn test data from any other similar facility (such as TOCDF) while treating chemical agent H, this test burn data will be used to estimate the stack gas emission rates for the CAMDS DFS while treating this agent. Due to

(1) the similarity of the CAMDS DFS and the TOCDF DFS and (2) the lack of trial burn test data for the CAMDS DFS while treating chemical agent GB; trial burn test data for the TOCDF DFS while treating chemical agent GB (EG&G 1998a; 1999a) will be used to estimate the stack gas emission rates for the CAMDS DFS while treating this agent. Section 2.4 describes the derivation of stack gas emission rate estimates for the CAMDS DFS.

#### **2.2.2.4 CAMDS Heating, Ventilation, and Air Conditioning Filter System**

The CAMDS HVAC filter system exhausts ventilation air from the MPF and DFS Building Complexes in order to (1) maintain a negative pressure inside each of these buildings and (2) contain any fugitive emissions. The CAMDS HVAC filter system consists of a series of activated carbon filters and HEPA filters to control the emission of organic compounds and particulate matter before the off-gas is emitted through nine separate stacks (CAMDS 1996).

No stack gas emission rate data is available for the CAMDS HVAC. Section 2.4 describes the derivation of stack gas emission rate estimates for the CAMDS HVAC.

#### **2.2.3 Hazardous Waste Storage Area Emission Sources**

Potential emissions from the various hazardous waste storage areas at DCD would be caused by leaking chemical agent from damaged or deteriorating chemical munitions or storage containers. To guard against this potential, the chemical munitions are stored in sealed concrete igloos and are transported from the igloos to TOCDF or CAMDS in specially designed sealed on-site containers (ONC). Each of the igloos is monitored by an ACAMS for the presence of chemical agent. Procedures are in place to immediately find and contain the source of the leak whenever chemical agent is detected (DSHW 1993).

The potential risks due to a catastrophic release of chemical agent from an igloo or ONC are not evaluated in the HHRA process (U.S. EPA 1998a). Furthermore, numerous conservative assumptions have been made regarding the other emission sources at DCD (see Section 2.4) that should compensate for the unlikely scenario that chemical agent is being emitted from each of the igloos at or just below the detection limit of the ACAMS. Therefore, emissions from the various hazardous waste storage areas will not be directly evaluated in the HHRA.

#### **2.2.4 Rapid Response System Emission Sources**

The RRS is a mobile chemical agent treatment system. The emissions from this type of treatment system are controlled by a series of filters including a pre-filter, two HEPA filters, two coconut shell activated carbon filters for the control of chloroform, and two ASZM-TEDA carbon filters for control of chemical agents before being vented into the interior of Building 4553 at DCD (DSHW 2000b). Building 4553 is maintained under negative pressure by an HVAC system. The HVAC filter system for Building 4553 consists of another series of activated carbon filters before being vented to the atmosphere. Both filter systems are equipped with ACAMS to detect any agent in the off-gas emissions from the RRS treatment process so that activated carbon filters can be replaced before they become ineffective at removing the residual agent from the gas stream prior to its release to the atmosphere.

The potential risks due to a catastrophic release of chemical agent from the RRS is not evaluated in the HHRA process (U.S. EPA 1998a). Furthermore, numerous conservative assumptions have been made regarding the other emission sources at DCD (see Section 2.4) that should compensate for the unlikely scenario that chemical agent will be emitted from Building 4553 at or just below the detection limit of the ACAMS. Finally, the process involved in approving the RRS Hazardous Waste Treatment Permit included a separate risk evaluation with regards to managing neutralized chemical agent. No elevated risks were identified (DSHW 2000b). Therefore, emissions from the RRS will not be directly evaluated in the HHRA.

### **2.3 COMPOUNDS OF POTENTIAL CONCERN**

COPCs are the chemicals that are evaluated in the HHRA. Potential COPCs for the emission sources at DCD include (1) chemical agents present in the chemical munition stockpile at DCD; (2) explosives, propellants, and other energetic compounds present as components of the chemical munition stockpile at DCD; (3) metals and other inorganic compounds present as components (casings or containers) in the chemical munition stockpile at DCD; (4) organic contaminants present in the components of the chemical munition stockpile at DCD (for example, polychlorinated biphenyls [PCB]); and (5) products of incomplete combustion (PIC) from the furnaces at TOCDF or CAMDS. PICs may include one of the following (U.S. EPA 1998a):

- Compounds initially present in the waste feed stream and not completely destroyed in the combustion process



- Compounds that are formed during the combustion process

PICs are typically categorized as volatile organic compounds (VOC), semivolatile organic compounds (SVOC), polychlorinated dibenzo(p)dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), and tentatively identified compounds (TIC).

In accordance with U.S. EPA guidance (1998a), the following 6 steps were followed to select the COPCs to be evaluated in the HHRA:

- Step 1:** Evaluate analytical data from the stack tests performed during the trial burn tests and compounds associated with fugitive emissions. Prepare a list which includes all the compounds specified in the analytical methods performed in the trial burn test, and fugitive emission evaluation. Describe whether the compound was detected or not detected.
- Step 2:** Evaluate the type of hazardous waste burned in the combustion unit—including all wastes that the unit will be permitted to burn—to determine whether any of the non-detect compounds should be retained for evaluation as COPCs because they are present in the waste.
- Step 3:** Delete from the list of COPCs those compounds that are non-detect, are not components of any combustion unit feed stream, and do not have toxicological data. From compounds that are detected but have no toxicological data, evaluate using surrogate toxicity data from a similar compound and retain on the COPC list.
- Step 4:** Delete from the list of COPCs those compounds that are non-detect, are not components of any combustion unit feed stream, and do not have a high potential to be emitted as PICs.
- Step 5:** Evaluate the 30 largest TIC peaks obtained during gas chromatography (GC) analysis to determine whether any of the TICs have toxicities similar to the detected compounds. If they do, consider surrogate toxicity data, as recommended in Step 3.
- Step 6:** Evaluate any compound that may be of concern due to other site-specific factors (for example, community and regulatory concern, high background concentrations). Include as COPCs those compounds that (1) are a concern due to site-specific factors, and (2) may be emitted by the combustion unit.

In order to consistently evaluate the potential risk from all of the emission sources at TOCDF and CAMDS, the same list of COPCs will be used for all of the emission sources. Section 2.4 describes the calculation of emission rates for each COPC for the different emission sources.

The following subsections (Sections 2.3.1 through 2.3.6) summarize the evaluation process for each of the six steps involved in the COPC selection process. Table 2-13 summarizes the COPCs identified and retained in each step of the COPC selection process. Section 2.3.7 summarizes the evaluation process and presents the final list of COPCs.

### **2.3.1 Step 1**

Step 1 of the COPC selection process involves the evaluation of analytical data from the stack tests performed during the trial burn tests and compounds associated with fugitive emissions.

The HHRA will evaluate the following TOCDF emissions: the TOCDF LIC1, TOCDF LIC2, TOCDF MPF, TOCDF DFS, TOCDF BRA, and TOCDF HVAC filter system. The sources to be evaluated in the HHRA for CAMDS include the CAMDS MPF, CAMDS DFS, and the CAMDS HVAC filter system. As discussed in Section 2.2 and described in detail in Section 2.4, stack gas emission rate data for all emission sources treating all types of chemical agent are not available. Therefore, emission rates used in the HHRA are based on (1) available trial burn test data from TOCDF and CAMDS or (2) emission rates from trial burn tests for similar units at another facility (CAMDS, TOCDF, or JACADS) when actual trial burn test data is not available.

Table 2-13 (1) identifies those COPCs that have been identified as target analytes in previous trial burn tests at TOCDF, CAMDS, and JACADS, and (2) denotes whether the COPC was detected during any trial burn test (all units and all agents) at each facility. All of the COPCs identified as target analytes were retained for further evaluation in Step 2.

### **2.3.2 Step 2**

Step 2 of the COPC evaluation process involves the identification of COPCs based on the presence of the compounds in the hazardous waste feed. Table 2-13 identifies those COPCs that have been identified as constituents of the waste feed in the RCRA permits for TOCDF, CAMDS, and JACADS. All of the COPCs identified as waste feed constituents (as well as the COPCs identified in Step 1) were retained for further evaluation in Step 3.

TABLE 2-13

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>b</sup>			Step 2	Step 3		Step 5			COPC <sup>c</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Waste Feed Constituent	Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	
Volatile Organic Compounds											
Acetone	67-64-1	[	[	[		[	[				QN
Benzene	71-43-2	[	[	[		[	[				QN
Bromodichloromethane	75-27-4	[	[			[	[				QN
Bromoethene (Vinyl Bromide)	593-60-2	[	[				[				QL
Bromoform	75-25-2	[		[		[	[				QN
Bromomethane (Methyl Bromide)	74-83-9	[	[	[		[	[				QN
2-Butanone (MEK)	78-93-3	[	[			[	[				QN
1,3-Butadiene	106-99-0	ND	ND				[				QL
Carbon Disulfide	75-15-0	[	[			[	[				QN
Carbon Tetrachloride	56-23-5	[	[			[	[				QN
Chlorobenzene	108-90-7	[	[			[	[				QN
Chlorodibromoethane		[									QL
Chloroethane (Ethyl Chloride)	75-00-3	[	ND			[	[				QN
Chloroform	67-66-3	[	[			[	[				QN
Chloromethane (Methyl Chloride)	74-87-3	[	[	[		[	[				QN
2-Chloropropane (Isopropyl chloride)	75-29-6	ND	ND				[				QL
Dibromochloromethane	124-48-1	[				[	[				QL
1,2-Dibromoethane (Ethylene Dibromide)	106-93-4	ND				[	[				QN
Dibromomethane (Methylene Bromide)	74-95-3	ND	ND			[	[				QN
cis-1,4-Dichloro-2-butene (2-Butene)	1476-11-5	ND	ND				[				QL
trans-1,4-Dichloro-2-butene	110-57-6	ND	ND								QL
Dichlorodifluoromethane (Freon 12)	75-71-8	[	ND			[	[				QN
1,1-Dichloroethane	75-34-3	ND	[			[	[				QN
1,2-Dichloroethane (EDC)	107-06-2	ND	[			[	[				QN
1,1-Dichloroethene	75-35-4	ND	ND			[	[				QN
trans-1,2-Dichloroethene	156-60-5	ND	ND			[	[				QN
1,2-Dichloropropane	78-87-5	ND	[	[		[	[				QN
cis-1,3-Dichloropropene	542-75-6	[	[	[		[	[				QN
trans-1,3-Dichloropropene	10061-02-6	[	[				[				QL

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
Ethylbenzene	100-41-4	[	[			[	[				QN
Iodomethane		[									QL
n-Hexane	110-54-3	ND	ND			[	[				QN
2-Hexanone (Methyl butyl ketone)	591-78-6	ND	ND								QL
Iodomethane (Methyl iodide)	74-88-4	[	ND	[							QL
Methylene Chloride	75-09-2	[	[	[		[	[				QN
4-Methyl-2-pentanone (Methyl IsoButyl Ketone)	108-10-1	ND	ND	[		[	[				QN
1,1,1,2-Tetrachloroethane	630-20-6	ND	[			[	[				QN
1,1,2,2-Tetrachloroethane	79-34-5	ND	ND	[		[	[				QN
Tetrachloroethene (PCE)		ND	[	[		[	[				QN
Toluene		[	[	[		[	[				QN
1,1,1-Trichloroethane (TCA)	71-55-6	[	[	[		[	[				QN
1,1,2-Trichloroethane	79-00-5	[	ND			[	[				QN
Trichloroethene (TCE)	79-01-6	[	ND			[	[				QN
1,2,3-Trichloropropane	96-18-4	[	ND			[	[				QN
Trichlorofluoromethane	75-69-4	[	ND			[	[				QN
Vinyl acetate	108-05-4	ND	ND	[		[	[				QN
Vinyl Chloride	75-01-4	[	[			[	[				QN
m-xylene	108-38-3					[	[				QN
p-Xylene	106-42-3					[	[				QN
M,p-Xylene		[	[								QL
o-Xylene	95-47-6	[	[			[	[				QN
<b>Total Xylenes</b>				[							QL
<b>Semi-volatile Organic Compounds</b>											
Acenaphthene	83-32-9	[	[			[	[				QN
Acenaphthylene	208-96-8	[	[								QL
Acetophenone	98-86-2	[	[			[	[				QN
2-Acetylaminofluorene	53-96-3	S	ND								QL
4-Aminobiphenyl (p-Biphenylamine)	92-67-1	[	[								QL
3-Amino-9-ethycarbazole	--	[	[								QL
Aniline	62-53-3	[	[			[	[				QN
Anthracene	120-12-7	[	[			[	[				QN
Aramite	140-57-8	[	[			[	[				QN

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
Benzidine	92-87-5	[	[				[				QL
Benzoic acid	65-85-0	[	[			[	[				QN
Benzo (a) anthracene	50-32-8	[	[			[	[				QN
Benzo (b) fluoranthrene	205-99-2	[	[			[	[				QN
Benzo (j) fluoranthrene	--	[	[								QL
Benzo (k) fluoranthrene	207-08-9	[	[			[	[				QN
Benzo (g,h,i) perylene	191-24-2	[	[				[				QL
Benzo (a) pyrene	50-32-8	[	[			[	[				QN
Benzo (e) pyrene	192-97-2	[	[								QL
Benzyl alcohol	100-51-6	[	[			[	[				QN
Benzaldehyde	100-52-7	[	ND			[	[				QN
Benzenethiol (Phenylmercaptan or Thiophenol)	108-98-5	ND	ND				[				QL
1,1'-Biphenyl (Phenylbenzene or Diphenyl)	92-52-4	ND	ND				[				QL
Bis(2-Ethylhexyl)-phthalate		[	[	[							QL
Butyl benzyl phthalate	85-68-7	[	[			[	[				QN
2-sec-Butyl-4,6-dinitro-phenol (Dinoseb)	88-85-7	ND									QL
4-Chloroaniline	106-47-8	[	[			[	[				QN
bis(2-Chloroethoxy)-methane	111-91-1	[	[								QL
bis(2-Chloroethyl)ether	111-44-4	[	[			[	[				QN
2,2'-Oxybis[1-chloropropane] (bis-chloroisopropyl-ether)	39638-32-9 a	ND	ND			[	[				QN
Chlorobenzilate	510-15-6	ND	ND			[	[				QN
4-Chloro-3-methylphenol	59-50-7	ND	[			[	[				QN
1-Chloronaphthalene	90-13-1	[	[								QL
2-Chloronaphthalene	91-58-7	[	[			[	[				QN
2-Chlorophenol	95-57-8	[	[			[	[				QN
4-Chlorophenyl-phenyl ether	7005-72-3	[	[			[	[				QN
Chrysene	218-01-9	[	[			[	[				QN
4,4'-DDE	72-55-9		ND			[	[				QN
Diallate	2303-16-4		ND				[				QL
Dibenz(a,h)anthracene	53-70-3	[	[			[	[				QN
Dibenz(a,j)acridine	224-42-0	[	[								QL
Dibenzofuran	132-64-9	[	[								QL

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
DBCP (1,2-Dibromo-3-chloropropane)	96-12-8		ND			[	[				QN
Di-n-butyl phthalate	84-74-2	[	[	[		[	[				QN
Di-n-octyl phthalate			[	[		[	[				QN
1,2-Dichlorobenzene	95-50-1	[	[			[	[				QN
1,3-Dichlorobenzene	541-73-1	[	[			[	[				QN
1,4-Dichlorobenzene	106-46-7	[	[			[	[				QN
3,3'-Dichlorobenzidine	91-94-1	[	[			[	[				QN
2,4-Dichlorophenol	120-83-2	[	[			[	[				QN
2,6-Dichlorophenol	87-65-0	[	[								QL
Dihydrosafrole	94-58-6		ND								QL
Diethyl phthalate	84-66-2	[	[	[		[	[				QN
Diisopropyl methylphosphonate	1445-75-6		ND				[				QL
p-(Dimethylamino)azobenzene	60-11-7	[	ND								QL
7,12-Dimethylbenz[a]-anthracene (DMBA)	57-97-6	[	ND								QL
3,3'-Dimethylbenzidine	119-90-4		ND			[	[				QN
a,a-Dimethylphenethyl-amine (Phentermine)	122-09-8	[	[								QL
2,4-Dimethylphenol	105-67-9	[	[			[	[				QN
Dimethyl phthalate	131-11-3	[	[	[		[	[				QN
1,3-Dinitrobenzene	99-65-0	ND	ND			[	[				QN
4,6-Dinitro-2-methylphenol (Dinitro-o-cresol)	534-52-1	[	[								QL
2,4-Dinitrophenol	51-28-5	[	[			[	[				QN
2,4-Dinitrotoluene	121-14-2	[	[			[	[				QN
2,6-Dinitrotoluene	606-20-2	[	[			[	[				QN
Diphenylamine		[	[								QL
Dioxathion	78-34-2		ND								QL
Di-n-octyl phthalate	117-84-0		ND			[	[				QN
1,2-Diphenylhydrazine	122-66-7	ND	ND			[	[				QN
N,N-Diphenylamine (Phenylbenzenamine)	122-39-4	ND	ND								QL
bis(2-Ethylhexyl)-phthalate	117-81-7	[				[	[				QN
Ethyl methanesulfonate	62-50-0	[	[			[	[				QN
Ethyl parathion (Parathion)	56-38-2	[	[				[				QL
Fluoranthene	206-44-0	[	[			[	[				QN
Fluorene	86-73-7	[	[			[	[				QN

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
Heptachlor	76-44-8		ND			[	[				QN
Hexachlorobenzene	118-74-1	[	[			[	[				QN
Hexachlorobutadiene		[	[								QL
Hexachloro-1,3-butadiene	87-68-3	[	ND			[	[				QN
Hexachlorocyclopentadiene	77-47-4	[	[			[	[				QN
Hexachloroethane	67-72-1	[	[			[	[				QN
Hexachlorophene	70-30-4	[	ND			[	[				QN
Hexachloropropene	1888-71-7	[	ND								QL
Indeno(1,2,3-cd)pyrene	193-39-5	[	[			[	[				QN
Isophorone	78-59-1	[	[			[	[				QN
Isosafrole	120-58-1		ND								QL
Methapyrilene	91-80-5		ND								QL
Methoxychlor	72-43-5		ND			[	[				QN
3-Methylcholanthrene	56-49-5	[	[								QL
Methylcyclohexane	108-87-2		ND								QL
Methyl methanesulfonate	66-27-3	[	[								QL
2-Methylnaphthalene	91-57-6	[	[								QL
2-Methyl-5-nitroaniline b	99-55-8		ND								QL
2-Methylphenol (o-Cresol)	95-48-7	[	[	[		[	[				QN
3-Methylphenol (m-Cresol)	108-39-4		ND	[		[	[				QN
4-Methylphenol (p-Cresol)	106-44-5	[	[	[		[	[				QN
¾-Methylphenol		[	[								QL
Naphthalene	91-20-3	[	[			[	[				QN
1-Naphthylamine		[	[								QL
2-Naphthylamine	91-59-8	[	[								QL
5-Nitroacenaphthene	602-87-9		ND								QL
2-Nitroaniline	88-74-4	[	[			[	[				QN
3-Nitroaniline	99-09-2	[	[			[	[				QN
Nitrobenzene	98-95-3	[	[			[	[				QN
2-Nitrophenol	88-75-5	[	[			[	[				QN
4-Nitrophenol	100-02-7	[	[			[	[				QN
4-Nitroquinoline 1-oxide	56-57-5		ND								QL
N-Nitroso-di-n-butylamine	924-16-3	[	[			[	[				QN

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
N-Nitrosodiethylamine (ethylamine)	55-18-5		[				[				QL
N-Nitrosodimethylamine	62-75-9	[	[				[				QL
N-Nitrosodiphenylamine	86-30-6	[	[			[	[				QN
N-Nitroso-di-n-propylamine	621-64-7	[	[			[	[				QN
N-Nitrosomethylethylamine (NMEA)	10595-95-6		ND				[				QL
N-Nitrosomorpholine	59-89-2		ND								QL
N-Nitrosopiperidine	100-75-4	[	[								QL
N-Nitrosopyrrolidine	930-55-2		ND				[				QL
5-Nitro-o-toluidine b	99-55-8		ND				[				QL
2,2'-Oxybis (1-chloropropane)		[	[								QL
Pentachlorobenzene	608-93-5	[	[			[	[				QN
Pentachloroethane	76-01-7		ND								QL
Pentachloronitrobenzene (PCNB)	82-68-8	[	[			[	[				QN
Pentachlorophenol	87-86-5	[	[			[	[				QN
Phenacetin	62-44-2	[	[								QL
Phenanthrene	85-01-8	[	[			[	[				QN
Phenol	108-95-2	[	[			[	[				QN
para-Phenylenediamine	106-50-3		ND				[				QL
2-Picoline	109-06-8	[	[								QL
Pronamide	23950-58-5	[	[			[	[				QN
Pyrene	129-00-0	[	[			[	[				QN
Pyridine	110-86-1		ND			[	[				QN
Quinoline	91-22-5		ND				[				QL
Safrole	94-59-1		ND			[	[				QN
1,2,4,5-Tetrachlorobenzene		[	[			[	[				QN
2,3,4,6-Tetrachlorophenol	58-90-2	[	[			[	[				QN
p-Toluidine	106-49-0		ND				[				QL
2-Toluidine	95-53-4		ND			[	[				QN
Tributylamine	102-82-9		ND								QL
1,2,4-Trichlorobenzene	120-82-1	[	[			[	[				QN
2,4,5-Trichlorophenol	95-95-4	[	[			[	[				QN
2,4,6-Trichlorophenol	88-06-2	[	[			[	[				QN
O,O,O-Triethylphosphorothioate	126-68-1		ND								QL



TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
1,3,5-Trinitrobenzene	99-35-4		ND			[	[				QN
2,4,6-Trinitrotoluene		[	[	[	[	[	[				QN
N,N'-Diisopropylcarbodiimide	693-13-0		ND								QL
<b>Tentatively Identified Compounds</b>											
2-Acetylaminofluorene								[	[		QL
Benzaldehyde								[	[		QL
Benzenethiol								[	[		QL
Biphenyl								[	[		QL
Bromoethene (Vinyl Bromide)								[			QL
1,3-Butadiene								[			QL
2-sec-Butyl-4,6-dinitro-phenol								[	[		QL
Chlorobenzilate								[	[		QL
2-Chloropropane								[			QL
4,4''-DDE								[	[		QL
Diallate								[	[		QL
BDCP (1,2-Dibromo-3-chloropropane)								[	[		QL
Dibromochloromethane								[	[		QL
1,2-Dibromoethane (Ethylene Dibromide)								[			QL
1,4-Dichloro-2-butene								[			QL
Cis-1,4-Dichloro-2-butene								[			QL
trans-1,4-Dichloro-2-butene								[			QL
Dihydrosafrole								[	[		QL
Diisopropyl methyl phosphonate								[			QL
3,3'-Dimethylbenzidine								[	[		QL
1,3-Dinitrobenzene								[	[		QL
Dioxathion								[	[		QL
1,2-Diphenylhydrazine								[	[		QL
Ethyl parathion								[	[		QL
Heptachlor								[	[		QL
Hexachlorophene								[	[		QL
Hexachloropropene								[	[		QL
n-Hexane								[			QL
2-Hexanone								[			QL

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
Isosafrole								[	[		QL
Methapyrilene								[	[		QL
Methoxychlor								[	[		QL
Methyl cyclohexane								[			QL
2-Methyl-5-nitroaniline								[	[		QL
4-Methyl-2-pentanone (MIBK)								[	[		QL
3-Methylphenol								[	[		QL
1,4-Naphthoquinone								[	[		QL
5-Nitroacenaphthene								[	[		QL
4-Nitroquinoline-1-oxide								[	[		QL
N-Nitrosodiethylamine								[	[		QL
N-Nitrosomethylethylamine								[	[		QL
N-Nitrosomorpholine								[	[		QL
N-Nitrosopyrrolidine								[	[		QL
5-Nitro-o-toluidine								[	[		QL
Nonane								[			QL
Pentachloroethane								[	[		QL
p-Phenylenediamine								[	[		QL
Quinoline								[	[		QL
2-Propanol								[			QL
Pyridine								[	[		QL
Safrole								[	[		QL
1,1,1,2-Tetrachloroethane								[	[		QL
p-Toluidine								[	[		QL
2-Toluidine								[	[		QL
Tributylamine								[	[		QL
1,1,2-Trichlorotrifluoroethane								[			QL
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)								[	[		QL
0,0,0-Triethylphosphorothioate								[	[		QL
1,3,5-Trinitrobenzene								[			QL
Vinyl Acetate								[	[		QL
N,N'-Diisopropylcarbodiimide								[	[		QL

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
2-4-dimethyl-1-heptene								[	[		QL
2-Decanal, (z)-								[	[		QL
3-Nonene (c,t)								[	[		QL
Acetophenone								[	[		QL
Benzaldehyde								[	[		QL
Benzene, (1-methylethyl)-								[	[		QL
Benzene, propyl-								[	[		QL
Benzonitrile								[	[		QL
Bezene,1,2,3-trichloro-								[	[		QL
Bezene,1,2,3-trimethyl								[	[		QL
Benzene,ethyl-methyl								[	[		QL
Benzene, propyl								[	[		QL
Carbonyl Sulfide								[	[		QL
Cyclohexane								[	[		QL
Cyclohexane,1,2,3,-trimethyl-								[	[		QL
Cyclohexane, butyl-								[	[		QL
Cyclohexane, diethyl								[	[		QL
Cychlohexane, methyl-propyl-								[	[		QL
Cyclohexane, propyl-								[	[		QL
Cyclopentane,1,2,3-trimethyl-								[	[		QL
Cyclopropane,1-butyl-1-methyl								[	[		QL
Decane								[	[		QL
Decane,2,2,5-tirmethyl								[	[		QL
Decane,2,2,6-trimethyl-								[	[		QL
Decane,2,2-dimethyl								[	[		QL
Decane,2,5,6-trimethyl								[	[		QL
Decane,2,6,6-trimethyl-								[	[		QL
Decane,2,6,8-trimethyl-								[	[		QL
Decane,3-methyl								[	[		QL
Decane,4-methyl								[	[		QL
Dodecane								[	[		QL
Heptane,3-ethyl-2methyl								[	[		QL
Heptane,4-ethyl								[	[		QL

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
Heptane,4-ethyl-2,2,6,6-tetra								[	[		QL
Heptane,5-ethyl-2,-methyl-								[	[		QL
Hexadecane,2,6,10,14-tetramet								[			QL
Hexatriacontane								[	[		QL
Methane,tribromo-								[	[		QL
Methyl nitrate								[	[		QL
Naphthalene,decahydro,trans								[	[		QL
Nonane								[	[		QL
Nonane,2,6-dimethyl								[	[		QL
Nonane,2-methyl-								[	[		QL
Nonane,3-methyl-								[	[		QL
Octane,2,2,6-trimethyl-								[	[		QL
Octane,2,3,6-trimethyl-								[	[		QL
Octane,2,5,6-trimethyl-								[	[		QL
Octane,3,5-dimethyl-								[	[		QL
Oxirane								[	[		QL
Tridecane								[	[		QL
Undecane								[	[		QL
Undecane-2,6-dimethyl-								[	[		QL
Butonic acid, methyl ester								[	[		QL
Toluene								[	[		QL
Cyclohexane,1-methyl-2-propyl								[	[		QL
Hexadecanoic acid								[	[		QL
Triphenyl phosphine oxide								[	[		QL
Hexacosane								[	[		QL
Heptacosane								[	[		QL
Octacosane								[	[		QL
Squalene								[	[		QL
1-Propanol,2-(2-methoxy-1-methylethoxy)								[	[		QL
2,2-Dimethoxybutane								[	[		QL
Butanoic acid, 2-methyl-, methyl ester								[	[		QL
Cyclopentane, 1,2,3,4,5-pentamethyl-								[	[		QL
2-Pentene, 3,4,4-trimethyl-								[	[		QL

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
Erucylamide								[	[		QL
4-Hydroxy-4-methyl-2-pentanone								[	[		QL
Diethylene glycol								[	[		QL
bis(2-Ethylhexyl)adipate								[	[		QL
Butanoic acid, propyl ester								[	[		QL
Phenol,4-4'-butylene bis[2-1,1-dimethylethyl]								[	[		QL
Silicic acid, tetramethyl ester								[	[		QL
Thipene,2,3-dimethyl-								[	[		QL
Acetic acid, (triphenylophosphor-anylidene)-methyl								[	[		QL
3-Penten-2-one, 4-methyl-								[	[		QL
2-Naphthalenecarbonoxaldehyde								[	[		QL
Octadecanoic acid								[	[		QL
Nonacosane								[	[		QL
<b>Miscellaneous Analytes</b>											
Agent GB (Sarin)	107-44-8	[	ND		[	[	[				QN
Chlorine		[	[		[	[	[				QN
VX	50782-69-9	[	ND		[	[	[				QN
HD	505-60-2	[	ND		[	[	[				QN
HCl	7647-01-0	[	[		[	[	[				QN
HF	7664-39-3	[	[		[	[	[				QN
Nitroglycerin		[			[	[	[				QN
Semivolatile TOC		[									QL
Nonvolatile TOC		[	[								QL
Volatile TOC		[	[								QL
Particulate Matter		[	[		[						QL
RDX		[			[	[	[				QN
HMX		[				[	[				QN
<b>Dioxins and Furans TEQs</b>											
2,3,7,8-TCDD	1746-01-6	[				[	[				QN
TCDD <sup>(4)</sup>		[									QN
1,2,3,7,8-PeCDD	40321-76-4	[				[					QN
PeCDD <sup>(4)</sup>		[									QN

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
1,2,3,4,7,8-HxCDD	39227-28-6	[				[					QN
1,2,3,6,7,8-HxCDD	57653-85-7	[	[			[					QN
1,2,3,7,8,9-HxCDD	19408-74-3	[	[			[					QN
Hexa CDD <sup>(4)</sup>		[	[								QN
1,2,3,4,6,7,8-HpCDD	35822-46-9	[	[			[					QN
Hepta CDD <sup>(4)</sup>		[	[								QN
OCDD	3268-87-9	[	[			[					QN
2,3,7,8-TCDF	51207-31-9	[	[			[					QN
TCDF <sup>(4)</sup>		[	[								QN
1,2,3,7,8-PeCDF	57117-41-6	[	[			[					QN
2,3,4,7,8-PeCDF	57117-31-4	[	[			[					QN
Penta CDF <sup>(4)</sup>		[	[								QN
1,2,3,4,7,8-HxCDF	70648-26-9	[	[			[					QN
1,2,3,6,7,8-HxCDF	57117-44-9	[	[			[					QN
2,3,4,6,7,8-HxCDF	60851-34-5	[	[			[					QN
1,2,3,7,8,9-HxCDF	72918-21-9	[				[					QN
Hexa CDF <sup>(4)</sup>		[	[								QN
1,2,3,4,6,7,8-HpCDF	67562-39-4	[	[			[					QN
1,2,3,4,7,8,9-HpCDF	55673-89-7	[	[			[					QN
Hepta CDF <sup>(4)</sup>		[	[								QN
OCDF	39001-02-0	[	[			[					QN
<b>Polychlorinated Biphenyls</b>											
Total monochlor biphenyls		[			[	[	[				QN
Total dichlorobiphenyls		[			[	[	[				QN
Total trichlorobiphenyls		[			[	[	[				QN
2,2',4,4'-TetraCB		[			[	[	[				QN
Total Tetrachlorobiphenyls		[			[	[	[				QN
2,3',4,4',5-Penta CB		[			[	[	[				QN
2,3,3',4,4'-Penta CB		[			[	[	[				QN
2,3,4,4',5-Penta CB		[			[	[	[				QN
2'2,4,4',5-Penta CB		[			[	[	[				QN
3,3',4,4',5-Penta CB		[			[	[	[				QN
Total Pentachlorobiphenyls		[			[	[	[				QN

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte		Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
2,3,3',4,4',5-Hexa CB		[			[	[	[				QN
2,3',4,4',5',5-Hexa CB		[			[	[	[				QN
3,3',4,4',5,5'-Hexa CB		[			[	[	[				QN
Total Hexachlorobiphenyls		[			[	[	[				QN
2,3,3',4,4',5,5'-Hepta CB		[			[	[	[				QN
2,2',3',4,4',5,5'-Hepta CB		[			[	[	[				QN
2,2',3,3',4,4',5'-Hepta CB		[			[	[	[				QN
Total Heptachlorobiphenyls		[			[	[	[				QN
Total Octachlorobiphenyls		[			[	[	[				QN
Total Nonachlorobiphenyls		[			[	[	[				QN
Deca CB											QN
<b>PCB Subtotals</b>											
<b>METALS</b>											
Aluminum	7429-90-5	[	[		[						QN
Antimony	7440-36-0	[	[		[	[	[				QN
Arsenic	7440-38-2	[	[	[	[	[	[				QN
Barium	7440-39-3	[	[	[	[	[	[				QN
Beryllium	7440-41-7	[	[		[	[	[				QN
Boron	7440-42-8	[	[	[	[						QN
Cadmium	7440-43-9	[	[		[	[	[				QN
Chromium	7440-47-3	[	[		[	[	[				QN
Hexavalent Chromium	18540-29-9	[	[		[						QN
Cobalt	7440-48-4	[	[		[						QN
Copper	7440-50-8	[	[		[						QN
Lead	7439-92-1	[	[	[	[	[	[				QN
Manganese	7439-96-5	[	[	[	[						QN
Mercury	7439-97-6	[	[		[	[	[				QN
Nickel	7440-02-0	[	[	[	[	[	[				QN
Phosphorus	7723-14-0	[	[	[	[						QN
Selenium	7782-49-2	[	[		[	[	[				QN
Silver	7440-22-4	[	[		[	[	[				QN
Thallium	7440-28-0	[	ND		[	[	[				QN
Tin	7440-31-5	[	[		[						QN

TABLE 2-13 (Continued)

SUMMARY OF COPC IDENTIFICATION PROCESS<sup>a</sup>

Compound	CAS #	Step 1 <sup>a</sup>			Step 2	Step 3		Step 5			COPC <sup>b</sup>
		TOCDF Target Analyte	CAMDS Target Analyte	JACADS Target Analyte	Waste Feed Constituent	Fate and Transport Parameter Values Available	Toxicity Values Available	TOCDF TIC	CAMDS TIC	JACADS TIC	
Vanadium	7440-62-2	[	ND		[						QN
Zinc	7440-66-6	[	[	[	[	[	[				QN

Notes:

<sup>a</sup> As described in Section 2.3.4, no COPCs were deleted as part of Step 4 of the COPC selection process; therefore, this step is not shown. Similarly, as discussed in Section 2.3.6, no COPCs were added as part of Step 6 of the COPC selection process; therefore, this step is not shown.

<sup>b</sup> A check appears in these columns if the compound was detected during any stack test at the particular facility.

<sup>c</sup> COPCs to be evaluated quantitatively are identified as “QN.” COPCs to be evaluated qualitatively are identified as “QL.”

CAMDS Chemical Agent Munitions Disposal System  
 CAS Chemical Abstract Service  
 COPC Compound of potential concern  
 JACADS Johnston Atoll Chemical Agent Disposal System  
 ND Non detect  
 PCB Polychlorinated biphenyl  
 TEQ Toxic equivalents  
 TIC Tentatively identified compound  
 TOCDF Tooele Chemical Agent Disposal Facility  
 TOE Total organic emissions  
 VOC Volatile organic compound



### 2.3.3 Step 3

Step 3 of the COPC identification process involves deleting compounds that are non-detect, are not components of any combustion unit feed stream, and do not have toxicological data (including fate and transport modeling parameters).

Table 2-13 identifies (1) analytes that have available fate and transport modeling parameters, (2) analytes that have available toxicological data, (3) analytes without toxicological data, and (4) analytes for which surrogate toxicity data may be used.

However, because this HHRA is being used to predict potential risk from some combustion sources for which emissions data are not yet available (that is, to conservatively compensate for the potential that a target analyte might in the future be detected during a trial burn test under conditions that have yet to be tested), no COPCs were deleted as part of Step 3. U.S. EPA (1998a) recommends that the waste be characterized to determine what constituents are likely to be present in the waste feed. The DSHW reviewed the waste characterization as part of the trial burn target analyte selection process. Some of the waste characterization is based on generator knowledge. For some of the waste, the generator knowledge cannot be confirmed with sampling because of personnel safety issues (for example, explosives). The lack of confirmation limits the efficacy of using waste analyses to predict emissions for the TOCDF and CAMDS.

Due to a lack of strong evidence to the contrary, non-detected target analytes were assumed to be present and were retained as COPCs. All non-detected inorganics were retained because of uncertainties regarding waste characterization. Based on possible reaction mechanisms, all non-detected VOCs were retained. The DSHW requires that the protectiveness of detection limits be established if frequency of detection is used as a COPC selection criterion for risk assessments. If chemical emissions at the detection limit result in potentially significant health risks, the chemical should be retained as a COPC. One way of evaluating the protectiveness of detection limits is to calculate the risks associated with chemicals present at the detection limit; that is, retain non-detected analytes as COPCs.

All of the COPCs identified as target analytes in Step 1 and waste feed constituents in Step 2 are retained for further evaluation in Step 4 (please note that for those compounds that have no toxicity or surrogate

toxicity data, only a qualitative evaluation of the potential risk from the emission of these COPCs will be possible—this issue is described in more detail in Sections 2.4 and Section 7.0).

#### **2.3.4 Step 4**

Step 4 of the COPC evaluation process involves deleting compounds that are non-detect, are not components of any combustion unit feed stream, and do not have a high potential to be emitted as PICs.

Similar to the case presented in Step 3, no COPCs were deleted in Step 4 because this HHRA is being used to predict potential risk from emission sources for which data are not yet available (that is, to conservatively compensate for the potential that a target analyte might in the future be detected during a trial burn test under conditions that have yet to be tested). All of the COPCs identified as target analytes in Step 1 and waste feed constituents in Step 2 are retained for further evaluation in Step 5.

#### **2.3.5 Step 5**

Step 5 of the COPC evaluation process involves the identification of the 30 largest TIC peaks obtained during GC analysis.

Table 2-13 identifies (1) compounds that have been identified as TICs during trial burn tests at each facility (all units and all agents), (2) TICs that have available fate and transport modeling parameters, (3) TICs that have available toxicological data, and (4) TICs for which surrogate toxicity data may be used.

All of the COPCs identified as target analytes in Step 1, waste feed constituents in Step 2, and TICs in Step 5 are retained for further evaluation in Step 6.

#### **2.3.6 Step 6**

Step 6 of the COPC evaluation process involves the identification of any additional compounds that may be of concern due to other site-specific factors (for example, community and regulatory concern and high background concentrations).

Table 2-13 identifies (1) compounds that have been identified due to site-specific factors, (2) compounds that have fate and transport modeling parameters, (3) compounds that have available toxicological data, and (4) compounds for which surrogate toxicity data may be used.

### **2.3.7 Compounds Of Potential Concern Identification Summary**

Based on the 6-step COPC selection process described in Sections 2.3.1 through 2.3.6 above, a final list of 200 COPCs that will be evaluated quantitatively were identified. As noted above, some compounds were retained as COPCs (even if toxicity values and fate and transport parameters were not available) to conservatively account for the potential that a target analyte might be detected during a trial burn test under conditions that have yet to be tested. These 217 COPCs, including numerous VOCs, SVOCs, TICs, and metals, will be evaluated in the HHRA on a qualitative basis and will be discussed in the uncertainty section of the report.

## **2.4 EMISSION RATE CALCULATIONS**

The HHRA will evaluate emissions for six sources located at TOCDF and three sources located at CAMDS. The sources at TOCDF include the LIC1, LIC2, MPF, DFS, BRA, and HVAC filter system. The sources at CAMDS include the MPF, DFS, and HVAC filter system. As discussed in Section 2.2, emissions from the various hazardous waste storage areas and RRS will not be quantitatively evaluated as part of the HHRA. This section identifies, however, several conservative assumptions made to calculate emission rates for COPCs that will be quantitatively evaluated that should account for the small potential emissions and risks from the various RCRA hazardous waste storage areas and RRS. These conservative assumptions are summarized in Section 9.0.

Stack gas emission rates were calculated for each emission source for each COPC identified in Table 2-13 based on stack gas concentrations and stack gas volumetric flow rates presented in available trial burn and test burn data. Emission rates were calculated based on (1) available trial burn test and test burn data from TOCDF and CAMDS, or (2) emission rates from trial burn tests for similar units at another facility (CAMDS, TOCDF, or JACADS) in cases where actual trial burn or test burn data are not available. Emission rate calculations were generally conducted in accordance with current U.S. EPA guidance (1998a). Deviations from this guidance are clearly identified and discussed.

Table 2-14 summarizes the information used to calculate the TOCDF and CAMDS emission rates. The following sections summarize the derivation of the emission rates in detail.

Section 2.4.1 describes the type and quality of the emissions data for those sources for which trial burn and test burn data are available. Section 2.4.2 describes the extrapolation procedures, and the quality assurance checks used to ensure the reasonableness of extrapolations for units where emission rate data from trial burn tests for similar units at another facility were used. Section 2.4.3 describes the determination of emission rates for the TOCDF BRA, TOCDF HVAC, and CAMDS HVAC.

Section 2.4.4 describes how emission rate values for nondetected compounds were determined for (1) trial burn data that presented nondetected COPC values, (2) trial burn data that did not present nondetected COPC values, and (3) trial burn data that did not include certain COPCs as target analytes.

Section 2.4.5 describes how the emission rate values to be used in the HHRA were determined.

Section 2.4.6 describes specific procedures that will be used to estimate the risk of PCDDs and PCDFs, PAHs, chromium, and lead in the HHRA.

#### **2.4.1 Source-Specific Emission Rates**

The following sections provide information about the emissions data that were used to derive COPC stack gas emission rates for the emission sources at TOCDF and CAMDS. Stack gas emission rate data for emission sources at TOCDF are summarized in Appendix A. Stack gas emission rate data for emission sources at CAMDS are summarized in Appendix B. Emission rate data for the TOCDF HVAC and BRA, and the CAMDS HVAC, are summarized in Appendix C.

##### **2.4.1.1 TOCDF LIC1 GB Emissions**

A trial burn test of the TOCDF LIC1 using agent GB was conducted in 1997 (EG&G 1998b). The results of this test are presented in Table A-1. In general, the TOCDF LIC1 GB trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; SVOC TICs; HCl; HF; particulate matter; total VOCs; total SVOCs; total nonvolatile

TABLE 2-14

## METHODOLOGY FOR EMISSION RATE CALCULATIONS AND EXTRAPOLATIONS

Unit	Chemical Agent	Feed Rate Extrapolation	Stack Gas Flow Rate Extrapolation	Date of Actual Trial Burn Data	Dioxin Data Available	Table Number in Attachments
<b>TOCDF</b>						
DFS	VX	Based on CAMDS DFS VX trial burn data; used actual CAMDS VX feed rate scaled to TOCDF DFS Part B permitted VX feed rate	Based on CAMDS DFS VX trial burn data; evaluated the ratio between CAMDS stack gas flow rate and TOCDF DFS flow rate from December 1997 GB trial burn	NA	Group-Specific	A-11
DFS	GB	Trial burn data available	Trial burn data available	December 1997	Congener-Specific	A-10
DFS	HD	No permitted HD feed rates available in Part B permit; extrapolated JACADS emission rates for GB bursters	Used JACADS DFS GB emission rate data and TOCDF DFS GB stack gas flow rate data	NA	Congener-Specific	A-12
MPF	HD	Based on JACADS MPF HD trial burn data; used actual JACADS HD feed rate scaled to TOCDF MPF Part B permitted HD feed rate	Based on JACADS MPF VX trial burn data; evaluated the ratio between JACADS stack gas flow rate and TOCDF MPF flow rate from August/September 1997 GB trial burn	NA	Group-Specific	A-9
MPF	GB	Trial burn data available	Trial burn data available	August/September 1997	Congener-Specific	A-7
MPF	VX	Based on CAMDS MPF VX trial burn data; compared permitted feed rates and extrapolated TOCDF MPF emissions based on ratio	Based on CAMDS MPF VX trial burn data; compared stack gas flow rates and extrapolated TOCDF MPF emissions based on ratio	NA	Congener-Specific	A-8
LIC 1 and LIC 2	GB	Trial burn data available	Trial burn data available	July 1998/LIC 1 October 1997/LIC 2	Congener-Specific	A-1 and A-2

TABLE 2-14 (Continued)

## METHODOLOGY FOR EMISSION RATE CALCULATIONS AND EXTRAPOLATIONS

Unit	Chemical Agent	Feed Rate Extrapolation	Stack Gas Flow Rate Extrapolation	Date of Actual Trial Burn Data	Dioxin Data Available	Table Number in Attachments
LIC 1 and LIC 2	HD	Based on JACADS LIC HD trial burn data; used actual JACADS HD feed rate scaled to TOCDF LIC Part B permitted HD feed rate	Based on JACADS LIC HD trial burn data; used actual JACADS HD stack gas flow rates scaled to TOCDF LIC flow rates corresponding to the maximum emission rate between LIC1 and LIC2 HD burns	NA	Group-Specific	A-5 and A-6
LIC 1 and LIC 2	VX	Based on JACADS LIC VX trial burn data; used actual JACADS VX feed rate scaled to TOCDF LIC Part B permitted VX feed rate	Based on JACADS LIC VX trial burn data; used actual JACADS VX stack gas flow rates scaled to TOCDF LIC flow rates corresponding to the maximum emission rate between LIC1 and LIC2 GB burns	NA	Group-Specific	A-3 and A-4
BRA	NA	Trial burn data available	Trial burn data available	December 1997	NA	C-1
HVAC	HD, GB, VX	NA	Used the MDL for the stack monitor for each chemical agent and the HVAC maximum stack gas flow rate for the CAMDS Part B permit. TOCDF HVAC assumed to be equivalent in size to the CAMDS HVAC	NA	NA	C-2
<b>CAMDS</b>						
DFS	HD	Trial burn data available	Trial burn data available	December 1992/DFS 1 July 1993/DFS 2 Used the maximum value between the two trial burns	Group-Specific	B-6a and B-6b
DFS	VX	Trial burn data available	Trial burn data available	December 1993	Group-Specific	B-5

TABLE 2-14 (Continued)

## METHODOLOGY FOR EMISSION RATE CALCULATIONS AND EXTRAPOLATIONS

Unit	Chemical Agent	Feed Rate Extrapolation	Stack Gas Flow Rate Extrapolation	Date of Actual Trial Burn Data	Dioxin Data Available	Table Number in Attachments
DFS	GB	CAMDS DFS not in existing Part B permit; cannot extrapolate based on feed rate	Based on TOCDF DFS GB trial burn data; compared stack gas flow rates to CAMDS DFS flow rates to develop factor	NA	Congener-Specific	B-4
MPF	GB	Trial burn data available	Trial burn data available	December 1994	Congener-Specific	B-1
MPF	VX	Trial burn data available	Trial burn data available	November 1994	Congener-Specific	B-2
MPF	HD	Based on JACADS MPF HD trial burn data; used actual JACADS HD feed rate scaled to CAMDS MPF Part B permitted HD feed rate	Based on JACADS MPF HD trial burn data; compared stack gas flow rates to CAMDS MPF HD flow rates to develop factor	NA	Group-Specific	B-3
HVAC	HD, GB, VX	NA	Used the MDL for the stack monitor for each chemical agent and the HVAC maximum stack gas flow rate from the CAMDS Part B permit.	NA	NA	C-3

## Notes:

BRA	Brine reduction area
CAMDS	Chemical Agent Munitions Disposal System
DFS	Deactivation furnace
GB	Isopropyl methylphosphonofluoridate
HD	Di-2-chloroethylsulfide
HVAC	Heating, ventilation, and air conditioning filter system
LIC	Liquid incinerator
MDL	Method detection limit
MPF	Metal parts furnace
NA	Not applicable
TOCDF	Tooele Chemical Agent Disposal Facility
VX	O-ethyl-S-[2-diisopropylaminoethyl]-methyl phosphonothiolate

compounds; 2,3,7,8-congener specific PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the method detection limit (MDL).

TOCDF GB trial burn test data for hexavalent chromium has been formally rejected by DSHW. In the absence of speciated hexavalent chromium data, it was conservatively assumed that all chromium emitted is in the hexavalent form (see Section 2.4.8).

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for GB is 0.0003 milligrams per cubic meter (mg/m<sup>3</sup>). The stack gas emission rate of GB for the TOCDF LIC1 has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF LIC1 GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.1.2 TOCDF LIC2 GB Emissions**

A trial burn test of the TOCDF LIC2 using agent GB was conducted in 1997 (EG&G 1997b). The results of this test are presented in Table A-2. In general, the TOCDF LIC2 GB trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; SVOC TICs; HCl; HF; particulate matter; total volatile organic compounds; total semivolatile organic compounds; total nonvolatile compounds; 2,3,7,8-congener specific PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the MDL.

TOCDF GB trial burn test data for hexavalent chromium has been formally rejected by DSHW. In the absence of speciated hexavalent chromium data, it was conservatively assumed that all chromium emitted is in the hexavalent form (see Section 2.4.8).

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for GB is 0.0003 mg/m<sup>3</sup>. The stack gas emission rate of GB for the TOCDF LIC2 GB has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF LIC2 GB trial burn test (all runs and all isokinetic sampling trains).



#### **2.4.1.3 TOCDF MPF GB Emissions**

A trial burn test of the TOCDF MPF using agent GB was conducted in 1997 (EG&G 1997a). The results of this test are presented in Table A-7. In general, the TOCDF MPF GB trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; SVOC TICs; HCl; HF; particulate matter; total VOCs; total SVOCs; total nonvolatile compounds; 2,3,7,8-congener specific PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the MDL.

TOCDF GB trial burn test data for hexavalent chromium has been formally rejected by DSHW. In the absence of speciated hexavalent chromium data, it was conservatively assumed that all chromium emitted is in the hexavalent form (see Section 2.4.8).

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for GB is 0.0003 mg/m<sup>3</sup>. The stack gas emission rate of GB for the TOCDF MPF GB has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF MPF GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.1.4 TOCDF DFS GB Emissions**

Two separate trial burn tests of the TOCDF DFS using agent GB were conducted: the first in 1997 and the second in 1999 (EG&G 1998a; 1999a). The results of the first TOCDF DFS GB trial burn test have been rejected by DSHW, except for the energetic compound emission rate data (nitroglycerin, trinitrotoluene, and RDX). Therefore, the data presented in Table A-10 represent the results of the second TOCDF DFS GB trial burn test, along with the energetic compound emission rate data for the first TOCDF DFS GB trial burn test.

In general, the second TOCDF DFS GB trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; SVOC TICs; HCl; HF; particulate matter; total VOCs; total SVOCs; total nonvolatile compounds; 2,3,7,8-congener specific PCDD/PCDF results; PCBs; and metals. All compounds detected at or below the detection limits were reported at the MDL.

TOCDF GB trial burn test data for hexavalent chromium has been formally rejected by DSHW. In the absence of speciated hexavalent chromium data, it was conservatively assumed that all chromium emitted is in the hexavalent form (see Section 2.4.8).

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for GB is 0.0003 mg/m<sup>3</sup>. The stack gas emission rate of GB for the TOCDF DFS has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF DFS GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.1.5 CAMDS MPF GB Emissions**

A trial burn test of the CAMDS MPF using agent GB was conducted in December 1994 (IT 1995). The results of this test are presented in Table B-1. In general, the CAMDS MPF GB trial burn test included comprehensive stack gas sampling activities for speciated VOCs; VOC TICs; speciated SVOCs; SVOC TICs; chlorine; HCl; particulate matter; congener-specific PCDD/PCDF results; and a reduced list of metals (12 metals—including the 10 BIF metals, plus copper and selenium). All compounds detected at or below the detection limits were reported at the MDL.

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for GB is 0.0003 mg/m<sup>3</sup>. The stack gas emission rate for the CAMDS MPF GB has been calculated based on this maximum concentration and the average stack gas flow rate measured during the CAMDS MPF GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.1.6 CAMDS MPF VX Emissions**

A trial burn test of the CAMDS MPF using agent VX was conducted in November 1994 (TRC 1994). The results of the test are presented in Table B-2. In general, the CAMDS MPF VX trial burn test included comprehensive stack gas sampling activities for speciated SVOCs; HCl; HF; particulate matter; 2,3,7,8-congener specific PCDD/PCDF results; 2,4-dinitrotoluene; 2,6-dinitrotoluene; and a reduced list of metals (12 metals—including the 10 BIF metals, plus copper and selenium). All compounds detected at or below the detection limits were reported at the MDL.

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for VX is  $0.0003 \text{ mg/m}^3$ . The stack gas emission rate for the CAMDS MPF VX has been calculated based on this maximum concentration and the average stack gas flow rate measured during the CAMDS MPF VX trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.1.7 CAMDS DFS VX Emissions**

A trial burn test of the CAMDS DFS using agent VX was conducted in December 1993 (TRC 1993). The results of this test are presented in Table B-5. In general, the CAMDS DFS VX trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; HCl; particulate matter; 2,3,7,8-group total PCDD/PCDF results; 2,4-dinitrotoluene; 2,6-dinitrotoluene; 2,4,6-trinitrotoluene; and a reduced list of metals (13 metals—including the 10 BIF metals, plus copper, nickel, and selenium). All compounds detected at or below the detection limits were reported at the MDL.

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for VX is  $0.0003 \text{ mg/m}^3$ . The stack gas emission rate of VX for the CAMDS DFS has been calculated based on this maximum concentration and the average stack gas flow rate measured during the CAMDS DFS VX trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.1.8 CAMDS DFS HD Emissions**

Two trial burn tests of the CAMDS DFS using agent HD were conducted in 1992 (AT 1992a; 1992b). Although the results of these two “test burns” are not considered complete trial burn tests by DSHW, these tests do represent the best available data for CAMDS DFS HD. In general, the CAMDS DFS HD trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; HCl; particulate matter; 2,3,7,8-group total PCDD/PCDF results; 2,4-dinitrotoluene; 2,6-dinitrotoluene; 2,4,6-trinitrotoluene; and a reduced list of metals (13 metals—including the 10 BIF metals, plus copper, nickel, and selenium). All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table B-6.

Although the actual measured test burn chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for HD is  $0.03 \text{ mg/m}^3$ . The stack gas emission rate of HD for the CAMDS DFS has been calculated based on this maximum concentration and the average stack gas flow rate measured during the CAMDS DFS HD test burns (all runs and all isokinetic sampling trains).

#### **2.4.2 Extrapolated Emission Rates**

JACADS, TOCDF, and CAMDS trial burn test data were reviewed to determine an appropriate method for scaling emission rate data from one facility to another in the cases where unit- and agent-specific trial burn test data is not available. After reviewing the available trial burn test data, it was determined that scaling the emission rate data based on both (1) the ratio of actual to permitted agent feed rates and (2) the ratio of actual to estimated stack gas flow rates were the most reasonable techniques. However, a consistent correlation between the stack gas concentrations could not be determined because the values varied extensively from COPC to COPC.

Four different extrapolations using feed rate data were possible: (1) JACADS to TOCDF, (2) JACADS to CAMDS, (3) TOCDF to CAMDS, and (4) CAMDS to TOCDF. The equations used to complete these extrapolations are described below.

Feed rate adjusted emission rates calculated from JACADS data were scaled to TOCDF using the following equation:

$$Q_{TOCDF} = Q_{JACADS} (FR_{TOCDF}/FR_{JACADS}) \quad \text{Equation 2-1}$$

where:

$$\begin{aligned} Q_{TOCDF} &= \text{Adjusted TOCDF emission rate grams per second (g/s)} \\ Q_{JACADS} &= \text{JACADS emission rate (g/s)} \\ FR_{TOCDF} &= \text{TOCDF permitted feed rate (pounds per hour [lbs/hr])} \\ FR_{JACADS} &= \text{JACADS feed rate (lbs/hr)} \end{aligned}$$

Feed rate adjusted emission rates calculated from JACADS data were scaled to CAMDS emissions using the following equation:

$$Q_{CAMDS} = Q_{JACADS} (FR_{CAMDS}/FR_{JACADS}) \quad \text{Equation 2-2}$$

where:

$$\begin{aligned} Q_{CAMDS} &= \text{Adjusted CAMDS emission rate (g/s)} \\ Q_{JACADS} &= \text{JACADS emission rate (g/s)} \\ FR_{CAMDS} &= \text{CAMDS permitted feed rate (lbs/hr)} \\ FR_{JACADS} &= \text{JACADS feed rate (lbs/hr)} \end{aligned}$$

Feed rate adjusted emission rates calculated from TOCDF data were scaled to CAMDS emissions using the following equation:

$$Q_{CAMDS} = Q_{TOCDF} (FR_{CAMDS}/FR_{TOCDF}) \quad \text{Equation 2-3}$$

where:

$$\begin{aligned} Q_{CAMDS} &= \text{Adjusted CAMDS emission rate (g/s)} \\ Q_{TOCDF} &= \text{TOCDF emission rate (g/s)} \\ FR_{CAMDS} &= \text{CAMDS permitted feed rate (lbs/hr)} \\ FR_{TOCDF} &= \text{TOCDF feed rate (lbs/hr)} \end{aligned}$$

Feed rate adjusted emission rates calculated from CAMDS data were scaled to TOCDF emissions using the following equation:

$$Q_{TOCDF} = Q_{CAMDS} (FR_{TOCDF}/FR_{CAMDS}) \quad \text{Equation 2-4}$$

where:

$$\begin{aligned} Q_{TOCDF} &= \text{Adjusted TOCDF emission rate (g/s)} \\ Q_{CAMDS} &= \text{CAMDS emission rate (g/s)} \\ FR_{TOCDF} &= \text{TOCDF permitted feed rate (lbs/hr)} \\ FR_{CAMDS} &= \text{CAMDS feed rate (lbs/hr)} \end{aligned}$$

Four different extrapolations using stack gas flow rate data were also possible: (1) JACADS to TOCDF, (2) JACADS to CAMDS, (3) TOCDF to CAMDS, and (4) CAMDS to TOCDF. The equations used to complete these extrapolations are described below.

Stack gas flow rate adjusted emission rates calculated from JACADS data were scaled to TOCDF emissions using the following equation:

$$Q_{TOCDF} = Q_{JACADS} (SGF_{TOCDF}/SGF_{JACADS}) \quad \text{Equation 2-5}$$

where:

$$\begin{aligned} Q_{TOCDF} &= \text{Adjusted TOCDF emission rate (g/s)} \\ Q_{JACADS} &= \text{JACADS emission rate (g/s)} \\ SGF_{TOCDF} &= \text{TOCDF stack gas flow rate (dry standard cubic feet per minute [dscfm])} \\ SGF_{JACADS} &= \text{JACADS stack gas flow rate (dscfm)} \end{aligned}$$

Stack gas flow rate adjusted emission rates calculated from JACADS data were scaled to CAMDS emissions using the following equation:

$$Q_{CAMDS} = Q_{JACADS} (SGF_{CAMDS}/SGF_{JACADS}) \quad \text{Equation 2-6}$$

where:

$$\begin{aligned} Q_{CAMDS} &= \text{Adjusted CAMDS emission rate (g/s)} \\ Q_{JACADS} &= \text{JACADS emission rate (g/s)} \\ SGF_{CAMDS} &= \text{CAMDS stack gas flow rate (dscfm)} \\ SGF_{JACADS} &= \text{JACADS stack gas flow rate (dscfm)} \end{aligned}$$

Stack gas flow rate adjusted emission rates calculated from TOCDF data were scaled to CAMDS emissions using the following equation:

$$Q_{CAMDS} = Q_{TOCDF} (SGF_{CAMDS}/SGF_{TOCDF}) \quad \text{Equation 2-7}$$

where:

$$\begin{aligned} Q_{CAMDS} &= \text{Adjusted CAMDS emission rate (g/s)} \\ Q_{TOCDF} &= \text{TOCDF emission rate (g/s)} \\ SGF_{CAMDS} &= \text{CAMDS stack gas flow rate (dscfm)} \\ SGF_{TOCDF} &= \text{TOCDF stack gas flow rate (dscfm)} \end{aligned}$$

Stack gas flow rate adjusted emission rates calculated from CAMDS data were scaled to TOCDF emissions using the following equation:

$$Q_{TOCDF} = Q_{CAMDS} (SGF_{TOCDF}/SGF_{CAMDS}) \quad \text{Equation 2-8}$$

where:

$$\begin{aligned} Q_{TOCDF} &= \text{Adjusted TOCDF emission rate (g/s)} \\ Q_{CAMDS} &= \text{CAMDS emission rate (g/s)} \\ SGF_{TOCDF} &= \text{TOCDF stack gas flow rate (dscfm)} \\ SGF_{CAMDS} &= \text{CAMDS stack gas flow rate (dscfm)} \end{aligned}$$

The maximum emission rate (most conservative value) between the feed rate and stack gas flow rate adjusted data was selected for evaluation in the HHRA.

Depending on the results of the quality assurance checks described above, the projected emission rates were adjusted (either up or down). Because a preliminary evaluation indicated that the potential errors are most significant for PCDD/PCDF emissions, quality assurance checks were performed on emissions data on these compounds.

In order to determine if the feed rate- and stack gas flow rate-based scaling factors accurately projected the emission rates from facility-to-facility, three types of quality assurance checks were conducted, as follows:

**Quality Assurance Check 1:** A comparison (or ratio) of projected emission rates to actual emission rates for units and agents where actual data is available, using the feed rate- and stack gas flow rate-based projection methods used for units and agents where data was unavailable (that is, Equations 2-1 through 2-8).

The projected emission rates were compared to actual emission rates for units and agents where actual data was available using the feed rate- and stack gas flow rate-based projection methods used for units and agents where data was unavailable. The following equation is an example of this check:

Actual TOCDF LIC GB data (from Tables A-1 and A-2)

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Projected TOCDF LIC GB data (from Equations 2-1 and 2-5)

**Quality Assurance Check 2:** A comparison (or ratio) of the projected emission rate data using the feed rate- and stack gas flow rate-based adjustment factors, assuming that the ratio of COPC emissions for a particular furnace (for example, the JACADS LIC) for different agents (for example, between GB and VX) will be equal to the ratio of COPC emissions for the same furnace at a different facility (for example, the TOCDF LIC) for the same agents (GB and VX).

Actual unit-specific emission rates for various agents were compared between different facilities. The following equation is an example of this check:

$$\frac{\text{Real JACADS LIC GB data}}{\text{Real JACADS LIC VX data}} = \frac{\text{Real TOCDF LIC GB data (from Tables A-1 and A-2)}}{\text{Projected TOCDF LIC VX data (using Equations 2-1 / 2-5)}}$$

**Quality Assurance Check 3:** A comparison of the projected emission rate data using the feed rate- and stack gas flow rate-based scaling factors involving the projection of data for a single facility (for example, the TOCDF MPF VX) using actual data from both the JACADS MPF VX trial burn test and the CAMDS MPF VX trial burn test.

The following equation is an example of this check:

$$\frac{\text{Projected TOCDF MPF VX data (using Equations 2-1 and 2-5)}}{\text{Projected TOCDF MPF VX data (using Equation 2-4 and 2-8)}}$$

Stack gas emission rate data for emission sources at TOCDF are summarized in Appendix A. Stack gas emission rate data for emission sources at CAMDS are summarized in Appendix B. The results of these checks are summarized in the stack gas emission rate spreadsheets in Appendices A and B.

The three quality assurance checks indicated that although the extrapolated emission rates were in some cases a factor of three to five times higher, they were almost exclusively within an order of magnitude. Therefore, these extrapolated emission rates are reasonable, while not being overly conservative.



#### **2.4.2.1 TOCDF LIC1 VX Emissions**

JACADS LIC VX emission rate data were extrapolated to project TOCDF LIC1 VX emission rates. A trial burn test of the JACADS LIC using agent VX was conducted in 1992 (SRI 1992b). In general, the JACADS LIC VX trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; particulate matter; 2,3,7,8-group total PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table A-3.

The JACADS LIC VX data was then extrapolated to project TOCDF LIC1 VX emission rates based on chemical agent feed rates (Equation 2-1) and stack gas flow rates (Equation 2-5). The JACADS LIC VX trial burn test feed rate was between 969 and 700 lbs/hr. The maximum allowable TOCDF LIC1 VX feed rate is 580 lbs/hr. Therefore, the Equation 2-1 extrapolation factor was 0.83. The JACADS LIC VX trial burn test stack gas flow rate was between 8,655 and 9,091 dscfm. The TOCDF LIC1 GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 3,574 dscfm. Therefore, the Equation 2-5 extrapolation factor was between 0.39 and 0.41. These extrapolated values are also presented in Table A-3.

Although the actual chemical agent emission rate in the trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for VX is  $0.0003 \text{ mg/m}^3$ . The stack gas emission rate of VX for the TOCDF LIC1 VX has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF LIC1 GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.2 TOCDF LIC2 VX Emissions**

JACADS LIC VX emission rate data were extrapolated to project TOCDF LIC2 VX emission rates. A trial burn test of the JACADS LIC using agent VX was conducted in 1992 (SRI 1992b). In general, the JACADS LIC VX trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; particulate matter; 2,3,7,8-group total PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table A-4.

The JACADS LIC VX data was then extrapolated to project TOCDF LIC2 VX emission rates based on chemical agent feed rates (Equation 2-1) and stack gas flow rates (Equation 2-5). The JACADS LIC VX trial burn test feed rate was between 969 and 700 lbs/hr. The maximum allowable TOCDF LIC2 VX feed rate is 580 lbs/hr. Therefore, the Equation 2-1 extrapolation factor was 0.83. The JACADS LIC VX trial burn test stack gas flow rate was between 8,655 and 9,091 dscfm. The TOCDF LIC2 GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 3,574 dscfm. Therefore, the Equation 2-5 extrapolation factor was between 0.39 and 0.41. These extrapolated values are also presented in Table A-4.

Although the actual chemical agent emission rate in the trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for VX is  $0.0003 \text{ mg/m}^3$ . The stack gas emission rate of VX for the TOCDF LIC2 VX has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF LIC2 GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.3 TOCDF LIC1 HD Emissions**

JACADS LIC HD emission rate data were extrapolated to project TOCDF LIC1 HD emission rates. A trial burn test of the JACADS LIC using agent HD was conducted in 1992 (SRI 1992c). In general, the JACADS LIC HD trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; particulate matter; 2,3,7,8-group total PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table A-5.

The JACADS LIC HD data was then extrapolated to project TOCDF LIC1 HD emission rates based on chemical agent feed rates (Equation 2-1) and stack gas flow rates (Equation 2-5). The JACADS LIC HD trial burn test feed rate was between 849 and 1,320 lbs/hr. The maximum allowable TOCDF LIC1 HD feed rate is 1,160 lbs/hr. Therefore, the Equation 2-1 extrapolation factor was between 0.88 and 1.37. The JACADS LIC HD trial burn test stack gas flow rate was between 8,217 and 9,690 dscfm. The TOCDF LIC1 GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 3,574 dscfm. Therefore, the Equation 2-5 extrapolation factor was between 0.37 and 0.43. These extrapolated values are also presented in Table A-5.

Although the actual chemical agent emission rate in the trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for HD is  $0.03 \text{ mg/m}^3$ . The stack gas emission rate of HD for the TOCDF LIC1 has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF LIC1 GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.4 TOCDF LIC 2 HD Emissions**

JACADS LIC HD emission rate data were extrapolated to project TOCDF LIC2 HD emission rates. A trial burn test of the JACADS LIC using agent HD was conducted in 1992 (SRI 1992c). In general, the JACADS LIC HD trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; particulate matter; 2,3,7,8-group total PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table A-6.

The JACADS LIC HD data was then extrapolated to project TOCDF LIC2 HD emission rates based on chemical agent feed rates (Equation 2-1) and stack gas flow rates (Equation 2-5). The JACADS LIC HD trial burn test feed rate was between 849 and 1,320 lb/hr. The maximum allowable TOCDF LIC2 HD feed rate is 1,160 lb/hr. Therefore, the Equation 2-1 extrapolation factor was between 0.88 and 1.37. The JACADS LIC HD trial burn test stack gas flow rate was between 8,217 and 9,690 dscfm. The TOCDF LIC2 GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 3,574 dscfm. Therefore, the Equation 2-5 extrapolation factor was between 0.37 and 0.43. These extrapolated values are also presented in Table A-6.

Although the actual chemical agent emission rate in the trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for HD is  $0.03 \text{ mg/m}^3$ . The stack gas emission rate of HD for the TOCDF LIC2 has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF LIC2 GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.5 TOCDF MPF VX Emissions**

CAMDS MPF VX emission rate data were extrapolated to project TOCDF MPF VX emission rates. A trial burn test of the CAMDS MPF using agent VX was conducted in November 1994 (TRC 1994). In general, the CAMDS MPF VX trial burn test included comprehensive stack gas sampling activities for speciated SVOCs; HCl; HF; particulate matter; 2,3,7,8-congener specific PCDD/PCDF results; 2,4-dinitrotoluene; 2,6-dinitrotoluene; and a reduced list of metals (12 metals—including the 10 BIF metals, plus copper and selenium). All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table A-8.

The CAMDS MPF VX data was then extrapolated to project TOCDF MPF VX emission rates based on chemical agent feed rates (Equation 2-4) and stack gas flow rates (Equation 2-8). The CAMDS MPF VX trial burn test feed rate was 31.40 lb/hr. The maximum allowable TOCDF MPF VX feed rate is 60.0 lb/hr. Therefore, the Equation 2-4 extrapolation factor was 1.91. The CAMDS MPF VX trial burn test stack gas flow rate was between 2,613 and 2,737 dscfm. The TOCDF MPF GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 5,070.4 dscfm. Therefore, the Equation 2-8 extrapolation factor was between 0.52 and 0.54. These extrapolated values are also presented in Table A-8.

Although the actual measured chemical agent emission rate in the trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for VX is  $0.0003 \text{ mg/m}^3$ . The stack gas emission rate of VX for the TOCDF MPF has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF MPF GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.6 TOCDF MPF HD Emissions**

JACADS MPF HD emission rate data were extrapolated to project TOCDF MPF HD emission rates. A trial burn test of the JACADS MPF using agent HD in ton containers was conducted in 1992 (SRI 1992d). A second trial burn test of the JACADS MPF using agent HD in undrained mortars was conducted in March 1999 (PMCD1999). In general, the JACADS MPF HD trial burn test conducted in 1992 included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; particulate matter; 2,3,7,8-group total PCDD/PCDF results; and metals. The JACADS MPF HD trial burn test conducted in March 1999 included comprehensive stack gas sampling for speciated VOCs; speciated SVOCs; SVOC TICs; HCl; HF; particulate matter; total VOCs; total SVOCs; total nonvolatile compounds; 2,3,7,8-congener specific PCDD/PCDF results; PCBs, and metals. For both trial burn tests, all compounds detected at or below the detection limits were reported at the MDL. The March 1999 trial burn test data were used because the data set is more comprehensive. These data are presented in Table A-9. Please note that although PCBs are not anticipated to be associated with the HD chemical munitions to be treated in the TOCDF MPF, these compounds were identified as target analytes for the JACADS MPF HD trial burn test and these emission rates have been extrapolated in order to calculate TOCDF MPF HD emission rates.

The JACADS MPF HD data was then extrapolated to project TOCDF MPF HD emission rates based on chemical agent feed rates (Equation 2-1) and stack gas flow rates (Equation 2-5). The JACADS MPF HD trial burn test feed rate was between 622.1 and 639.4 lb/hr. The maximum allowable TOCDF MPF HD feed rate is 86.4 lb/hr. Therefore, the Equation 2-1 extrapolation factor was 0.14. The JACADS MPF HD trial burn test stack gas flow rate was between 4,347 and 4,703 dscfm. The TOCDF MPF GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 5,070.4 dscfm. Therefore, the Equation 2-5 extrapolation factor was between 0.86 and 0.93. These extrapolated values are also presented in Table A-9.

Although the actual measured trial burn test chemical agent emission rate was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for HD is  $0.03 \text{ mg/m}^3$ . The stack gas emission rate of HD for the TOCDF MPF has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF MPF GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.7 TOCDF DFS VX Emissions**

CAMDS DFS VX emission rate data were extrapolated to project TOCDF DFS VX emission rates. A trial burn test of the CAMDS DFS using agent VX was conducted in 1993 (TRC 1993). In general, the CAMDS DFS VX trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; PCBs; particulate matter; 2,3,7,8-congener specific PCDD/PCDF results; 2,4-dinitrotoluene; 2,6-dinitrotoluene; 2,4,6-trinitrotoluene; diphenylamine; RDX; HMX; and a reduced list of metals (12 metals—including the 10 BIF metals, plus copper and selenium). All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table A-11.

The CAMDS DFS VX data was then extrapolated to project TOCDF DFS VX emission rates based on chemical agent feed rates (Equation 2-4) and stack gas flow rates (Equation 2-8). The CAMDS DFS VX trial burn test feed rate was 60 units per hour (rockets). The maximum allowable TOCDF DFS VX feed rate is 70 units per hour (rockets). Therefore, the Equation 2-4 extrapolation factor was 1.14. The CAMDS DFS VX trial burn test stack gas flow rate was between 1.87 and 2.08 dry standard cubic meter per second (dscms). The TOCDF DFS GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 4.92 dscms. Therefore, the Equation 2-8 extrapolation factor was between 2.37 and 2.63. These extrapolated values are also presented in Table A-11.

Although the actual measured chemical agent emission rate in the trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for VX is  $0.0003 \text{ mg/m}^3$ . The stack gas emission rate of VX for the TOCDF DFS has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF DFS GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.8 TOCDF DFS HD Emissions**

JACADS DFS GB emission rate data (collected while feeding GB bursters) were used to project TOCDF DFS HD emission rates. A trial burn test of the JACADS DFS using agent GB while feeding bursters was conducted in 1998 (Raytheon 1998). In general, the JACADS DFS GB trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; particulate matter; 2,3,7,8-group total PCDD/PCDF results; PCBs; and metals. All compounds detected at or below the detection limits were reported at the MDL. These data are presented in Table A-12. Please note that although PCBs are not anticipated to be associated with the HD chemical munitions to be treated in the TOCDF DFS, these compounds were identified as target analytes for the JACADS DFS GB trial burn test and these emission rates have been extrapolated in order to calculate TOCDF DFS HD emission rates.

Although there are no current plans to treat HD-contaminated munitions in the TOCDF DFS, bursters from HD-filled projectiles will be processed in the TOCDF DFS. In preparing the emission rate estimates for the TOCDF DFS HD, extrapolated JACADS DFS GB data for calculating TOCDF DFS HD emission rates were compared to TOCDF DFS GB data. The TOCDF DFS GB data was considered in order to determine if it represented worst-case emission rates for the treatment of HD projectile bursters in the TOCDF DFS because (1) the bursters from the GB and HD projectiles are similar, and (2) the actual TOCDF DFS GB trial burn test data collected while treating M55 rockets was considered to be worst-case waste that would conservatively represent emission rates while treating GB projectile bursters. However, it was determined that the emission rates from the extrapolated JACADS DFS GB trial burn test (Raytheon 1998) were higher than the TOCDF DFS GB trial burn test emission rates (EG&G 1998a; 1999a); therefore, the extrapolated data from the JACADS DFS GB trial burn test will be used to complete the HHRA.

JACADS DFS GB data was used to extrapolate TOCDF DFS HD emission rates based on stack gas flow rates (Equation 2-5). A feed rate extrapolation was not possible because there is no permitted TOCDF DFS HD feed rate limit. The JACADS DFS GB trial burn test stack gas flow rate was between 3.08 and 3.33 dscms. The TOCDF DFS GB trial burn test stack gas flow rate (average of all runs and all isokinetic sampling trains) was 4.92 dscms. Therefore, the Equation 2-5 extrapolation factor was between 1.48 and 1.60. These extrapolated values are also presented in Table A-12.

Although the actual measured chemical agent emission rate in the trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for HD is  $0.03 \text{ mg/m}^3$ . The stack gas emission rate of HD for the TOCDF DFS has been calculated based on this maximum concentration and the average stack gas flow rate measured during the TOCDF DFS GB trial burn test (all runs and all isokinetic sampling trains).

#### **2.4.2.9 CAMDS MPF HD Emissions**

JACADS MPF HD emission rate data were extrapolated to project CAMDS MPF HD emission rates. A trial burn test of the JACADS MPF using agent HD was conducted in 1992 (SRI 1992d). A second trial burn test of the JACADS MPF using agent HD in undrained mortars was conducted in March 1999 (PMCD1999). In general, the JACADS MPF HD trial burn test conducted in 1992 included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; chlorine; HCl; HF; particulate matter; 2,3,7,8-group total PCDD/PCDF results; and metals. The JACADS MPF HD trial burn test conducted in March 1999 included comprehensive stack gas sampling for speciated VOCs; speciated SVOCs; SVOC TICs; HCl; HF; particulate matter; total VOCs; total SVOCs; total nonvolatile compounds; 2,3,7,8-congener specific PCDD/PCDF results; and metals. For both trial burn tests, all compounds detected at or below the detection limits were reported at the MDL. The March 1999 trial burn test data were used because the data set is more comprehensive. These data are presented in Table B-3.

The JACADS MPF HD data was then extrapolated to project CAMDS MPF HD emission rates based on chemical agent feed rates (Equation 2-2) and stack gas flow rates (Equation 2-6). The JACADS MPF HD trial burn test feed rate was between 622.1 and 639.4 lb/hr. The maximum allowable CAMDS MPF HD feed rate is 33.75 lb/hr. Therefore, the Equation 2-1 extrapolation factor was 0.05. The JACADS MPF HD trial burn test stack gas flow rate was between 4,347 and 4,703 dscfm. The average of the CAMDS MPF GB and CAMDS MPF VX trial burn test stack gas flow rates (average of all runs and all isokinetic sampling trains) was 3,528 dscfm. Therefore, the Equation 2-6 extrapolation factor was between 0.74 and 0.81. These extrapolated values are also presented in Table B-3.

Although the actual chemical agent emission rate for the measured trial burn was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for HD is  $0.03 \text{ mg/m}^3$ . The stack gas emission rate for the CAMDS



MPF HD has been calculated based on this maximum concentration and the average stack gas flow rate measured during the CAMDS MPF GB and CAMDS MPF VX trial burn tests (all runs and all isokinetic sampling trains).

#### **2.4.2.10 CAMDS DFS GB Emissions**

For CAMDS DFS GB emission rates, TOCDF DFS GB emission rate data were extrapolated to project CAMDS DFS GB emission rates. Two separate trial burn tests of the TOCDF DFS using agent GB were conducted: the first in 1997 and the second in 1999 (EG&G 1998a; 1999a). The results of the first TOCDF DFS GB trial burn test have been rejected by DSHW, except for the energetic compound emission rate data (nitoglycerin, trinitrotoluene, and RDX). Therefore, the data presented in Table B-4 represent the results of the second TOCDF DFS GB trial burn test, along with the energetic compound emission rate data for the first TOCDF DFS GB trial burn test.

In general, the second TOCDF DFS GB trial burn test included comprehensive stack gas sampling activities for speciated VOCs; speciated SVOCs; SVOC TICs; HCl; HF; particulate matter; total VOCs; total SVOCs; total nonvolatile compounds; 2,3,7,8-congener specific PCDD/PCDF results; and metals. All compounds detected at or below the detection limits were reported at the MDL.

TOCDF GB trial burn test data for hexavalent chromium has been formally rejected by DSHW. In the absence of speciated hexavalent chromium data, the total chromium value will be conservatively considered as the hexavalent chromium emission rate in order to complete the HHRA (see Section 2.4.8).

The TOCDF DFS GB data was then extrapolated to project CAMDS DFS GB emission rates based on chemical agent feed rates (Equation 2-3) and stack gas flow rates (Equation 2-7). The TOCDF DFS GB trial burn test feed rate was 33 units per hour. The maximum allowable CAMDS DFS GB feed rate is 25 units per hour. Therefore, the Equation 2-3 extrapolation factor was 0.76. The TOCDF DFS GB trial burn test stack gas flow rate was between 9,980 and 10,919 dscfm. The average of the CAMDS DFS VX trial burn test stack gas flow rates (average of all runs and all isokinetic sampling trains) was 4,164 dscfm. Therefore, the Equation 2-7 extrapolation factor was between 0.38 and 0.42. These extrapolated values are also presented in Table B-4.

Although the actual chemical agent emission rate for the measured trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration for GB is  $0.0003 \text{ mg/m}^3$ . The stack gas emission rate for the CAMDS DFS GB has been calculated based on this maximum concentration and the average stack gas flow rate measured during the CAMDS DFS VX trial burn test (all runs and all isokinetic sampling trains).

### **2.4.3 Other Emission Sources To Be Evaluated**

This section describes how COPC emission rates were calculated for the other emission sources at TOCDF and CAMDS: the TOCDF BRA, TOCDF HVAC, and CAMDS HVAC. Stack gas emission rate data for these emission sources are summarized in Appendix C.

#### **2.4.3.1 TOCDF BRA Emissions**

A compliance test of the TOCDF BRA was conducted in 1997 using brines generated while processing GB-contaminated munitions (EG&G 1997c). The TOCDF BRA compliance test results were rejected by the facility and DSHW because of a tear in one of the BRA PAS baghouse bags, which resulted in higher than normal emission rates. Because this is the only stack gas emission rate data available for the TOCDF BRA, these data are presented in Table C-1. In general, the TOCDF BRA compliance test includes comprehensive stack gas sampling activities for HCl; particulate matter; and a reduced list of metals (13 metals—including the 10 BIF metals, plus copper, nickel, and selenium). All compounds detected at or below the detection limits were reported at the MDL.

Although the actual chemical agent emission rate for the measured trial burn test was lower, DSHW has directed that the HHRA be completed using the maximum permitted agent emission rates. The maximum permitted stack gas concentration is  $0.0003 \text{ mg/m}^3$  for GB,  $0.0003 \text{ mg/m}^3$  for VX, and  $0.03 \text{ mg/m}^3$  for HD. The stack gas emission rate of chemical agents for the TOCDF BRA have been calculated based on these maximum concentrations and the average stack gas flow rate measured during the TOCDF BRA compliance test (all runs and all isokinetic sampling trains).

#### **2.4.3.2 TOCDF HVAC Emissions**

No emissions data are available for the HVAC systems at TOCDF. However, because the TOCDF HVAC is used to control fugitive emissions from the CHB and MDB, only the emission rate of chemical agent from the HVAC stack will be considered in the HHRA. The other potential contaminants controlled by the HVAC (energetics, metals, inorganics, and organic contaminants such as PCBs) are assumed to either be sufficiently nonvolatile or controlled by the TOCDF HVAC HEPA filters such that the emission rate of these compounds is insignificant. PICs are not emitted from the TOCDF HVAC.

The emission rate of chemical agents from the TOCDF HVAC were calculated based upon (1) the MDL for the TOCDF HVAC stack gas ACAMS for each agent (GB, VX, and HD) and (2) the maximum stack gas flow rate projected by the facility (MRI 1999). These data are presented in Table C-2. The TOCDF HVAC is not expected to be a significant source of chemical agent emissions. The emission rate of chemical agents from the TOCDF HVAC is expected to be much lower than the MDL for the ACAMS.

#### **2.4.3.3 CAMDS HVAC Emissions**

No emissions data are available for the HVAC systems at CAMDS. However, because the CAMDS HVAC is used to control fugitive emissions from the MPD and DFS Building Complexes, only the emission rate of chemical agent from the HVAC stack will be considered in the HHRA. The other potential contaminants controlled by the HVAC (energetics, metals, inorganics, and organic contaminants such as PCBs) are assumed to either be sufficiently nonvolatile or controlled by the CAMDS HVAC HEPA filters such that the emission rate of these compounds is insignificant. PICs are not emitted from the CAMDS HVAC.

The emission rate of chemical agents from the TOCDF HVAC were calculated based upon (1) the MDL for the TOCDF HVAC stack gas ACAMS for each agent (GB, VX, and HD) and (2) the maximum stack gas flow rate projected by the facility (MRI 1999). These data are presented in Table C-3. The CAMDS HVAC is not expected to be a significant source of chemical agent emissions. The emission rate of chemical agents from the CAMDS HVAC is expected to be much lower than the MDL for the ACAMS.

#### **2.4.4 Non-Detected COPCs**

The trial burn test data used to develop the COPC emission rate estimates for the emission sources at TOCDF and CAMDS were taken from numerous trial burn tests conducted between 1990 and 1999 by several different stack testing companies and analytical laboratories. During this timeframe, U.S. EPA guidance regarding the completion of trial burn tests, risk assessments, and analytical methods has evolved considerably. Therefore, although all of the data that was used to calculate the COPC emission rates for the HHRA is of high quality, the data was generated for a variety of different end uses, and is not always comparable. The issue of non-comparability effects the handling of non-detected COPCs in two very important ways:

- Current U.S. EPA guidance (1998a) recommends that non-detected COPCs be evaluated in the HHRA using (1) the reliable detection limit (RDL) for VOCs and SVOCs, (2) the estimated detection limit (EDL) for PCDD/PDCFs, and (3) the laboratory-reported MDL for metals. However, the analytical data presented in the various trial burn reports referenced in Sections 2.4.1, 2.4.2, and 2.4.3 include a variety non-detected values presented as MDLs, EDLs, practical quantitation limits (PQL), and sample quantitation limits (SQL). In fact, in many cases the format of the non-detected data (according to the strict detection limit definitions presented in U.S. EPA [1998a]) cannot be determined from the trial burn report.
- The analytical data presented in the various trial burn reports referenced in Sections 2.4.1, 2.4.2, and 2.4.3 include a variety of different target analyte lists (that is, all of the trial burn tests did not include the laboratory analytical activities necessary to quantify the emission rates of a comprehensive list of COPCs). However, because this HHRA is being used to predict potential risk from emission sources for which data is not yet available (that is, to conservatively compensate for the potential that a target analyte might be detected during a trial burn test under conditions that have yet to be tested), it was necessary to assume that COPCs for which no analytical data was available were present at the detection limit.

The following subsections describe the procedures used to address these issues.

##### **2.4.4.1 Detection Limit Reporting**

As noted above, the analytical data presented in the various trial burn reports referenced in Sections 2.4.1, 2.4.2, and 2.4.3 include a variety of non-detected values presented as MDLs, EDLs, PQLs, and SQLs. Rather than reevaluate all of the trial burn test results and recalculate all of the non-detected emission rates to be consistent with U.S. EPA guidance (1998a), emission rates for all non-detected compounds have been reported at the value presented in the original (trial burn report)

source. This approach is generally considered to be conservative because (1) the SQL and PQL are typically 5 to 10 times higher than the MDL and (2) the RDL is only 2.263 times the MDL (U.S. EPA 1998a).

#### **2.4.4.2 Detection Limit Substitution**

As noted above, the analytical data presented in the various trial burn reports referenced in Sections 2.4.1, 2.4.2, and 2.4.3 do not include analytical data to support the calculation of emission rates for many VOC, SVOC, PCDD/PCDF, and metal COPCs. In order to consistently evaluate the potential risk for a consistent list of COPCs for all of the emission sources at TOCDF and CAMDS, the COPC emission rate estimates were completed by assuming that the COPCs for which analytical data was not available were present at the COPC-specific detection limit values from the TOCDF GB trial burn tests for a particular furnace (except for the CAMDS MPF, where JACADS MPF HD detection limit information was used).

This substitution was completed for all VOC, SVOC, PCDD/PCDF, and metal COPCs. This substitution was not completed for TICs; total organic emissions (TOE) data (see Section 2.4.5.2); congener-specific PCDD/PCDF data (see Section 2.4.6); or hexavalent chromium data (see Section 2.4.8). A substitution for PCBs was made for the TOCDF DFS VX only. M55 rockets treated in the DFS are expected to be the only source of PCBs due to feed contamination. PCBs are not expected in the LIC or MPF at either TOCDF or CAMDS.

#### **2.4.5 Methodology for Emission Rate Correction Factors**

Following the calculation of the COPC emission rates described in Sections 2.4.1 through 2.4.4, the values for several factors were corrected as recommended by current U.S. EPA guidance (1998a). The following subsections describe the procedures used to (1) correct the run-specific measured COPC emission rates to a maximum COPC emission rate, (2) correct the COPC emission rates for TOE rates, (3) correct the COPC emission rates for process upsets, and (4) correct for worst-case metal and chlorine emission rates.

Please note that blank corrections were not performed in accordance with current U.S. EPA guidance (1998a). U.S. EPA recommends that if COPCs are detected in the blank samples, the sample should be

quantified at the COPC concentration in the blank sample if the detected blank concentration is 5 times greater than the detected stack gas concentration (U.S. EPA 1998a).

#### 2.4.5.1 Maximum Emission Rate Correction

The available trial burn test emission rates were measured during normal operating (risk burn test) conditions. In accordance with current U.S. EPA guidance (U.S. EPA 1998a), reasonable maximum emission rates were calculated by using the lower of either (1) the 95 percent upper confidence limit (UCL) emission rate value or (2) the maximum stack gas emission rate value.

The following equation was used to calculate the 95 percent UCL value of emission rates from multiple trial burn test runs:

$$95UCL = x + t \left( \frac{s}{\sqrt{n}} \right) \quad \text{Equation 2-9}$$

where:

95UCL	=	95 percent upper confidence limit
x	=	Arithmetic mean of stack gas concentrations
t	=	Student t-test value for data set
n	=	Number of samples in the data set
s	=	Standard deviation

The calculated 95 percent UCL values and maximum values are presented in the spreadsheets in Appendices A and B.

#### 2.4.5.2 Total Organic Emission Rate Correction

TOE rate information is collected during a trial burn test using the Guidance for Total Organics (U.S. EPA 1996b). Additional procedures for collecting TOE information—which is completed using U.S. EPA Method 0010 and 0040 stack gas sampling trains—are also provided in U.S. EPA (1998a) and U.S. EPA (1998b).

TOE rate data are collected during a trial burn test to determine the percentage (mass basis) of the total organic emissions that are quantified using various stack gas sampling and analytical methods that

quantitatively identify individual speciated compounds. For example, Methods 0030 and 8260B are used to speciate VOC; Methods 0010 and 8270C are used to speciate SVOC; and Methods 0023A and 8290 are used to speciate PCDD/PCDFs.

Only a limited amount of TOE data are currently available regarding the emissions from JACADS, TOCDF, and CAMDS. Additionally, a review of the CAMDS and JACADS trial burn test reports indicates that most of the total organic data presented in these reports come from the stack gas continuous emission monitoring system (CEMS) total hydrocarbon (THC) analyzers—data collected using U.S. EPA Method 25A. Data collected following Method 25A is not comparable to data collected following the Guidance for Total Organics (U.S. EPA 1996b). Therefore, only the most recent JACADS and TOCDF data have complete TOE data that were collected following U.S. EPA (1996b) guidance.

As a result, although the correction factors that have been calculated are relatively low (as compared to other observed correction factors—see below), a TOE modifier was not used for any quantitative emission rate calculations. A TOE modifier has been calculated and presented on the spreadsheets in Appendices A, B, and C. However, this data will only be used to complete the uncertainty section of the risk assessment (see Section 8.0). This is consistent with current U.S. EPA guidance (1998a), which recommends that TOE data be used during the risk assessment process only to *qualitatively* evaluate the uncertainty of the quantitative risk assessment results.

U.S. EPA's recommendation is based on several factors: (1) the relative newness of the methods; (2) inconsistent use of the method to collect TOE rate data during trial burn tests; and, most importantly, (3) significant questions regarding the accuracy and representativeness of the Guidance for Total Organics results—especially the gravimetric (nonvolatile) portion of the data (U.S. EPA 1998a; Cudahy and others 2000). The uncertainty associated with the last issue is apparent in the range of correction factors that have been observed from various trial burn tests conducted at a variety of sites throughout the country. Based on information available when the guidance document was prepared, U.S. EPA (1998a) cited a range of TOE correction factors between 2 and 40. More recent, larger databases indicate that the fraction of the total organic compounds speciated by trial burn tests can range from between 0.3 to 1,200 percent (Schofield and Eicher 2000).

Finally, the extrapolation of TOE modifiers for similar furnaces and similar agents between different facilities (for example, JACDS LIC HD to TOCDF LIC HD) does not introduce any added benefit to the

completion of the estimated emission rates, and most likely introduces additional errors and uncertainties into the overall risk assessment. Therefore, TOE modifiers were not extrapolated for similar furnaces and similar agents between facilities to account for a lack of TOE trial burn test data (for example, JACADS MPF VX to CAMDS MPF VX).

#### **2.4.5.3 Process Upset Emission Rate Correction**

The emission rates evaluated in the HHRA account for abnormal combustion conditions (process upsets) that might occur during startup, shutdown, or other production upsets. Site-specific process upset factors reported in TOCDF's *Incinerator Upset Conditions Estimate for 1998* (EG&G 1999b) were applied to all of the TOCDF emission rate calculations. EG&G analyzed TOCDF facility operating records and data for the MPF, DFS, LIC1, and LIC2. These factors are derived by assuming that COPC emission rates during process upsets are 10 times greater than COPC emission rates measured during the trial burn test. Since a unit does not continually operate under upset conditions, the factor must be adjusted to account for only the period of time, on an annual basis, that a unit operates under upset conditions. For example, for LIC1, it was determined that non-peak particulate and metals emissions control occurred 0.011 percent of the operating time in 1998, and non-peak organic emissions control occurred during 0.371 percent of operating hours in 1998. That is, the furnace is expected to operate as measured during the trial burn test conditions 99.629 percent of the year and under upset conditions the remaining 0.371 percent of the year. The organic compound upset factor was calculated as follows:  $[(1-0.00371)(1) + (0.00371)(10) = 1.03]$ . Similarly, for inorganic compounds, the combustion unit is assumed to operate as measured during the trial burn 99.9989 percent of the year and operate under upset conditions the remaining 0.0011 percent of the year. The inorganic upset factor was calculated as follows:  $[(0.999989)(1) + (0.000011)(10) = 1.00]$ .

For TOCDF LIC1 and TOCDF LIC2, an upset factor of 1.0 was used for inorganic compounds and an upset factor of 1.04 was used for organic compounds. For the TOCDF DFS, an upset factor of 1.0 was used for both inorganic and organic compounds. For the TOCDF MPF, an upset factor of 1.02 was applied to inorganic compounds and an upset factor of 1.0 was applied to the organic compounds. Based on discussions with technical staff at EG&G, it was determined that the 1998 site-specific upset factors were reasonable to represent upset conditions at TOCDF over a period of 30 years.



Default process upset factors, as recommended in U.S. EPA's *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (1998a), were applied to the CAMDS emission rates because no site-specific data were available. The derivation of upset emissions is based on studies by the California Air Resources Board (CARB). Emissions during process upsets are assumed to be 10 times greater than emissions measured during the trial burn. For organic compounds, it is assumed that the facility operates as measured for 80 percent of the year and under upset conditions for 20 percent of the year. Therefore, the adjustment factor for organic compounds is 2.8. For metals, it is assumed that the facility operates as measured for 95 percent of the year and under upset conditions for 5 percent of the year. Therefore, the adjustment factor for metals is 1.45.

#### **2.4.5.4 Metal and Chlorine Emission Rate Correction**

Previous risk assessments completed for TOCDF have included correction factors for metal and chlorine emission rates in order to account for worst case metal and chlorine feed rates (and therefore, worst case metal and chlorine emission rate) data that were not available at the time the risk assessment was completed. No metal or chlorine emission rate corrections were applied to the metal or chlorine emission rate values presented in Appendices A, B, or C. The following discussion describes the rationale for this decision.

As explained in Section 4.2.7 of the TOCDF Screening Risk Assessment, DSHW requested that some TOCDF metal and chlorine emission rates be revised to reflect similar changes made for the screening risk assessment at the Anniston Army Depot Chemical Demilitarization Facility (ANCDF) (A.T. Kearney 1996). Initially, the metal emission rates for the TOCDF Screening Risk Assessment were based on trial burn test data from JACADS. The JACADS trial burn tests were conducted using munitions that could potentially produce maximum chemical agent emission rates. Based upon a review of this data, DSHW determined that various metal and chlorine emission rates based on these "worst-case chemical agent emission rate" tests might not be representative of campaigns involving higher metals and chlorine feed rates (that is, a "worst-case metal emission rate" test or a "worst-case chlorine emission rate" test).

Therefore, DSHW reviewed available munitions feed rate information in order to identify the munitions that would result in the maximum metals and chlorine feed rates for the TOCDF DFS and MPF.

According to the TOCDF Screening Risk Assessment, DSHW identified the 8-inch projectile containing GB as the munition representing the worst-case metals and chlorine emission rate for the TOCDF DFS

and the M55 rocket containing GB as the munition representing the worst-case metals and chlorine feed rate for the TOCDF MPF (A.T. Kearney 1996). Because these munitions differed from those used during the JACADS trial burn tests, DSHW determined that revisions should be made to the metals and chlorine emission rates extrapolated from the JACADS trial burn tests. Please note that the TOCDF Screening Risk Assessment apparently identifies the incorrect worst case munition for the TOCDF MPF, since no component of the M55 rockets are fed to this furnace (A.T. Kearney 1996).

Furthermore, the impact of the revised emission rate approach was reviewed during the preparation of the draft protocol. Based upon this review, it was concluded that: (1) the revised procedures impact the barium, cadmium, chromium, lead, and nickel emission rates for the TOCDF DFS VX and TOCDF MPF HD data, and the chloride emission rate for the TOCDF DFS VX data; and (2) the differences between the initial JACADS data and the revised JACADS data were limited to less than an order of magnitude (or even the same value). It also appears that following the emission rate revisions, the revised JACADS metal emission data was entered by A.T. Kearney into the spreadsheets and extrapolated to TOCDF data; however, this extrapolation had already been completed as part of the procedures described in Section 4.2.7.1 and Table 4-7 and did not need to be completed (A.T. Kearney 1996). There may also have been errors introduced into the Screening Risk Assessment due to the fact that incorrect worst case munition was identified; however, this issue has not been thoroughly investigated.

Finally, the 1998 TOCDF DFS GB trial burn test was completed using M55 rockets containing residual agent. The TOCDF MPF GB trial burn test was completed using ton containers containing residual agent. Both tests were conducting using metal spiking compounds to represent worst case metal feed rates regardless of the munition type (EG&G 1997a; 1997b; and 1998b).

Based on these observations, the revised metal emission rates calculation procedures were not used to estimate TOCDF emission rate data that is extrapolated from JACADS data. Worst-case metal feed rate data, and presumably worst-case metal emission rate data, are available from the TOCDF GB trial burn tests.

#### **2.4.6 Modeling PCDDs and PCDFs, PAHs, Chromium, and Lead**

Specific procedures are used to estimate the risk of PCDDs and PCDFs, PAHs, chromium, and lead. Sections 2.4.6.1 through 2.4.6.4 discuss how these COPCs will be evaluated in the HHRA.

#### **2.4.6.1 Polychlorinated Dibenzo(p)dioxin and Polychlorinated Dibenzofuran Emissions**

There are 210 individual PCDD and PCDF compounds or “congeners.” U.S. EPA (1998a) has developed a methodology for assessing cancer risks associated with exposure to PCDDs and PCDFs. These procedures are based on the relative toxicity of 2,3,7,8-tetrachlorodibenzo(p)dioxin (TCDD). U.S. EPA (1998a) recommends that all HHRAs include PCDD or PCDFs with chlorine molecules substituted in the 2, 3, 7, and 8 positions. There are a total of 17 tetrachlorinated, pentachlorinated, hexachlorinated, heptachlorinated, and octachlorinated PCDDs and PCDFs that have chlorine molecules in the 2, 3, 7, and 8 positions. Each congener has been assigned a value, referred to as a toxicity equivalency factor (TEF), which corresponds to its toxicity in relation to the toxicity of 2,3,7,8-TCDD. The TEFs for these 17 congeners are listed in Table 2-15.

There are practical limitations with the available PCDD and PCDF emissions data. The JACADS, TOCDF, and CAMDS trial burn reports, referenced in Sections 2.4.1 and 2.4.2 are presented differently: some of the data is congener-specific (a separate value for each of the 17 2,3,7,8-substituted PCDDs and PCDFs), while the rest of the data only reports total isomer group information (that is, a value only for total 2,3,7,8-tetrachlorinated dibenzo(p)dioxins, 2,3,7,8-pentachlorinated dibenzo(p)dioxins, etc.).

Therefore, for those furnaces and agents where congener-specific PCDD/PCDF data are available (whether actual or extrapolated), each 2,3,7,8-congener will be modeled individually until media concentrations are calculated (see Section 6.0). Then, these concentrations will be converted to 2,3,7,8-TCDD toxic equivalents (TEQ) values for calculating risk (see Section 7.0).

For furnaces and agents where only total isomer group data are available (whether actual or extrapolated), the isomer group will be modeled by applying the total isomer group value to the congener that will result in the highest media concentration (as determined by a congener’s physical/chemical properties and biotransfer factors presented in U.S. EPA 1998a—see Section 6.0). Note that the TEFs are the same for all of the congeners with a given isomer group (Table 2-15); therefore, relative toxicity does not impact this procedure.

**TABLE 2-15**  
**TOXICITY EQUIVALENCY FACTORS FOR DIOXINS AND FURANS**

Dioxin and Furan Congeners	Toxicity Equivalency Factor (unitless)
2,3,7,8-TCDD	1.0
1,2,3,7,8-PCDD	0.5
1,2,3,4,7,8-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-HeCDD	0.01
1,2,3,4,5,7,8,9-OCDD	0.001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HeCDF	0.01
1,2,3,4,7,8,9-HeCDF	0.01
1,2,3,4,6,7,8,9-OCDF	0.001

Notes:

HeCDD	Heptachlorodibenzo(p)dioxin
HeCDF	Heptachlorodibenzofuran
HxCDD	Hexachlorodibenzo(p)dioxin
HxCDF	Hexachlorodibenzofuran
OCDD	Octachlorodibenzo(p)dioxin
OCDF	Octachlorodibenzofuran
PCDD	Pentachlorodibenzo(p)dioxin
PCDF	Pentachlorodibenzofuran
TCDF	Tetrachlorodibenzofuran
TCDD	Tetrachlorodibenzo(p)dioxin

Source: U.S. EPA 1998a

#### **2.4.6.2 Polycyclic Aromatic Hydrocarbons**

Polycyclic aromatic hydrocarbons (PAH) are readily formed in combustion units by either (1) dechlorination of other PAHs present in the waste feed or emissions stream (such as dioxins), or (2) the reaction of simple aromatic compounds (benzene or toluene) present in the waste feed or emissions stream. PAHs are well known as the principal organic components of emissions from all combustion sources. Therefore, based on the toxicity and combustion chemistry of PAHs, U.S. EPA (1998a) recommends that PAHs be evaluated in all combustion-related risk assessments.

At present, most of the research on PAHs has been performed on benzo(a)pyrene (BaP), the only PAH that has been subjected to oral carcinogenesis bioassays to approximate the National Toxicology Program (NTP) standard (U.S. EPA 1998a). Various non-bioassay results have been used to determine relative potency factors (RPF) for the class B2 carcinogen PAHs. The RPFs for these seven class B2 PAHs are presented in Table 2-16.

Therefore, each PAH will be modeled individually to calculate media concentrations and lifetime average daily dosage (LADD) (see Section 6.0). The RPFs presented in Table 2-16 and the BaP CSF will be used to calculate class B2 PAH-specific CSFs. These class B2 PAH-specific CSFs will be multiplied by the LADD for each PAH compound to complete the HHRA.

#### **2.4.6.3 Chromium**

The oxidation state of chromium is a critical factor in evaluating its toxicity and the risks associated with exposure. Hexavalent chromium ( $\text{Cr}^{+6}$ ) is the most toxic valence state of chromium and has been shown to be carcinogenic through inhalation exposure (U.S. EPA 2000). Trivalent chromium ( $\text{Cr}^{+3}$ ), a less oxidized form of chromium, has not been shown to be carcinogenic in either humans or laboratory animals (U.S. EPA 2000). U.S. EPA has indicated that chromium emitted from a combustion unit is not likely to be in the hexavalent form; however, there is no sufficient evidence to reliably estimate the partitioning of chromium emissions into these two valence states (U.S. EPA 1990a; 1990b). Therefore, unless site sampling or process-specific information is provided, the worst-case assumption—that 100 percent of the facility chromium emissions are in the hexavalent form—will be applied in the HHRA.

**TABLE 2-16****RELATIVE POTENCY FACTORS FOR  
POLYCYCLIC AROMATIC HYDROCARBONS**

<b>Polycyclic Aromatic Hydrocarbon</b>	<b>Relative Potency Factors (unitless)</b>
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	0.1

Source: U.S. EPA 1998a

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In the event risks or hazards associated with chromium exceed target levels based on the initial conservative assumption that exposure is entirely due to hexavalent chromium, risks and hazards will be recalculated assuming potential receptors are exposed to trivalent chromium through indirect exposure pathways (that is, ingestion of fish, beef, pork, chicken, dairy products, and produce). These additional risk estimates will be presented in the HHRA report with hexavalent chromium estimates, and discussed in the uncertainty section of the report. The assumption that receptors are exposed through direct exposure pathways (that is, inhalation of air) to hexavalent chromium will be maintained in the absence of site-specific data.

#### **2.4.6.4 Lead**

U.S. EPA does not currently list a reference dose (RfD) or reference concentration (RfC) for lead, because a threshold level for lead exposure has not yet been established. Based on findings that neurobehavioral effects have been observed in children with blood lead levels below those that have caused carcinogenic effects in laboratory animals, a CSF has not been derived by U.S. EPA. U.S. EPA has relied on the neurological effects observed in children as the sensitive endpoint for evaluating lead toxicity. Consequently, U.S. EPA has developed the Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children. This model evaluates potential risks based on predicted blood lead levels associated with exposure to lead (U.S. EPA 1994). The IEUBK model integrates several assumptions about the complex exposure pattern and physiological handling of lead by the body, and it has been validated at several sites at which lead exposure data and human blood lead levels are available.

U.S. EPA has also developed an *Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* (U.S. EPA 1996c). This interim model is intended for “assessing adult lead risks associated with nonresidential [industrial] exposure scenarios.” However, in general, children are more susceptible to lead exposures than adults because of higher soil ingestion rates and greater absorption by the gut, in addition to nutritional variables and lower body weight. U.S. EPA’s interim approach for assessing adult exposures to lead is based not on limiting adult toxicity, but rather on fetal toxicity by limiting indirect fetal exposure through direct maternal exposures to lead.

Based on this information, U.S. EPA recommends that HHRAs evaluating lead as a COPC use the IEUBK model instead of evaluating carcinogenic risks or noncarcinogenic hazards (U.S. EPA 1998a).

When run with standard recommended default values (generally representing national averages, or “typical” values), U.S. EPA’s IEUBK model predicts that no more than 5 percent of children exposed to a lead concentration in soil of 400 milligram per kilogram (mg/kg) will have lead concentrations in blood exceeding 10 micrograms per decaliter (µg/dL).